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DATA REPORT

to

**„ESTIMATION OF THE TOTAL FISH
BIOMASS IN THE BALTIC SEA DURING THE
20TH CENTURY“**

with addition to

**„ESTIMATION OF SOME FISH SPECIES'
BIOMASSES IN THE BALTIC SEA DURING
THE 20TH CENTURY“**

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A. BIOMASS IN THE BALTIC SEA DURING THE 20TH CENTURY

1. INTRODUCTION

The main report, „Estimation of the total fish biomass in the Baltic Sea during the 20th century“, is based on a number of data records ascertained from the literature, several of which are rather voluminous. These data had to be handled in various ways. Both, the data sets and their treatments, are so spacious that their inclusion in the main report would be disproportionate in relation to the intention of the main report. They are therefore dealt with in this data report.

The arrangement of tables and figures follows the structuring of the main report. The exception is section 2.6 on reliability which is added here in addition to the sections in the main report. Reference to tables and figures in the main report is made by clean numbers (e.g., Table 10). A „DR“ is added to those of the data report (e.g., DR, Table 10). References to authors as given in the tables state always a single (first) author, even if there were co-authors.

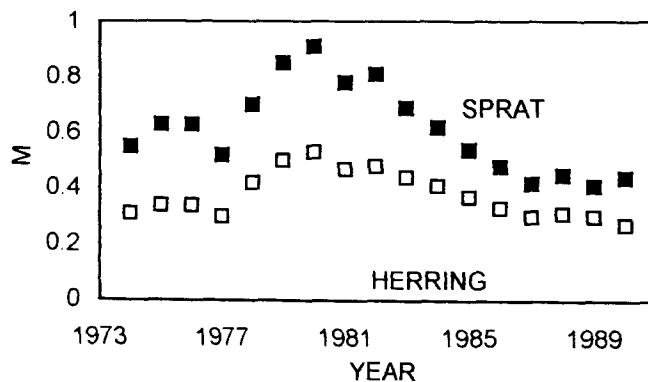


Figure 1: $M=(M_c+M_r)$ of clupeids in the central Baltic
(Anon. b.1991)

2. DATA AND METHODS

2.1 MORTALITIES

(MC+MR)

The coefficients of predation by cod, and residual mortality, MC+MR, of clupeids are largely driven by predation by cod. They were highest, when cod achieved its highest biomass around 1980 (DR, Figure 1). Such high biomasses are unlikely to have existed ever before (Thurow, 1993). The lowest level of (MC+MR) estimated on the basis of Multispecies VPA (Anon.b, 1991) was therefore assumed to apply to the years before 1977. Average annual values for 1974-90, as estimated by the Assessment Working Group (AWG), are shown in DR, Figure 1. The average at age for 1977-90 is depicted in DR, Figure 2. Mean levels (average for 1974-77, 1986-90), thought to apply for the period before 1977, are 0.3 for herring and 0.5 for sprat. The values in DR, Figures 1+2 have been used to downgrade (MC+MR) at age to these levels. The coefficients of natural mortality as used here are set out in DR, Table 1.

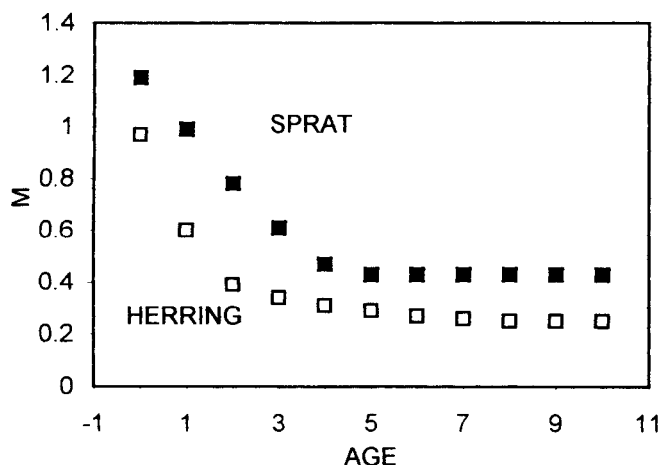


Figure 2: $M = (Mc+Mr)$ of clupeids in the central Baltic (Anon.b, 1991)

WEIGHTING

In order to estimate the coefficient ($F+M_M$) over all ages, it must be weighted by the biomass of each age group, $N \cdot w$. The question arises, what was the weight like in the early years? R.Aps (1989) indicated a steady increase in weight at age of sprat in the Gulf of Finland from 1955 to 1972. Strzyzewska & Popiel (1974) have shown for herring in subdivision 25 that the mean lengths were lowest in 1939. Subsequently, they increased to a much higher level in the middle of the forties and remained rather stable until 1971. Mean length at age of cod in the Baltic main basin was low by about 1920. It increased to a higher level 1930-1970 and showed a further rise thereafter (Thurow, 1974b). It is therefore assumed that the lowest range in the weight at age arrays established by the Assessment Working Groups (AWG) would represent conditions before about 1970. Since these weights

are exclusively used to weight the estimated ($F+M_M$), an error in the above assumption would have little effect. The lowest weights at age in Anon.b,d,1991 were selected. An example is shown for herring in the main basin in DR, Figure 3 (Anon.c,1990; Anon.b,1991). Smoothed curves were used for all stocks (DR, Table 2).

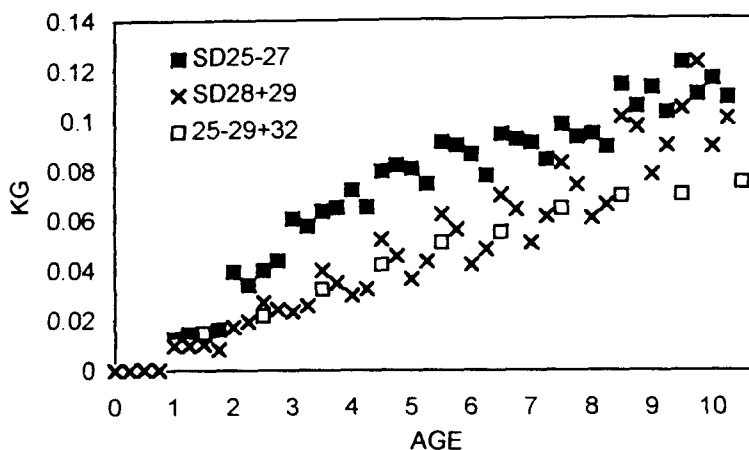


Figure 3: Mean weight, herring, central Baltic
(Anon.b,1990,1991)

POOLING

The Catch Curve Method refers to subsequent ages of the same year-class. This is not true for the present data. Annual sets are composed of different year-classes. For these the method would work only if the strength of year-classes would not change very much from year to year. Heavy variations could distort the catch curve and the estimated coefficient of total mortality, Z . To minimize the effect of fluctuations in recruitment, age compositions given by particular authors have been averaged over several years wherever the data source permitted this. Thus, for sprat the 71 sets are averaged over 1 - 5 years and cover a mean pooling period of 2.5 years. A number of 155 herring samples ranges 1 - 10 year with a mean of 3.3 years. Cod is represented by 96 age compositions over 1 - 7 years with a mean of 4.0 years (DR, Table 3).

FIT OF DATA SETS

Age compositions extracted from literature and used for mortality estimates are shown in DR, Tables 4-6. A weighted ($F+M_M$) for ages ≥ 1 , estimated for each set is stated. In some cases, when the data did not fit a single straight line, the first group of ages linearly arranged and thought to be fully exploited was used for the regression. The first ages were used as they make the greatest contribution to mortality as evaluated here. These selected ages are underlined in the tables. In sprat, 3 series are treated this way, in herring 9, and in cod none. Three herring sets from the same author did fit a straight line only for ages 7-10, likely caused by strong recruitment variations (DR, Table 5). This had to be accepted.

AGE FROM LENGTH

Some age compositions have been set up from conversion of length measurements. Sprat is completed this way by DR, Table 7. Six samples of Meyer (1942) of the years 1935-41 have been converted by means of age-length compositions of Dixon (1932, 1937) for the years 1931-35. Three herring length samples of the years 1920-22 (Henking, 1920, 1921, 1922) were expressed in terms of age by use of a table of Altnöder (1928) for 1927. Three further herring samples of the years 35-41 (Meyer, 1942) were converted by age-length keys of Meyer (1942) for 1940-41 (DR, Tab. 8-10).

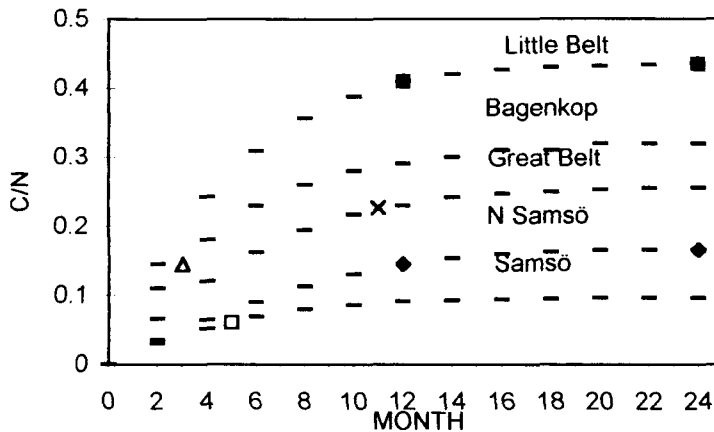


Figure 4: Recapture rates, C/N, of tagged cod in SD 22, compare Table 11, --- extrapolated values

TAGGING EXPERIMENTS

Five sets in DR, Table 6 refer to tagging experiments by Strubberg (1922) on cod in the Belt Sea (SD 22). The recaptures are stated for various periods in liberty (DR, Table 11). Three periods have various lengths. For two trials recaptures are given after 12 and 24 months each. These latter permit the setting up of curves (free hand) for the recapture rate over time (DR, Figure 4). The recapture rate is the number of returns © divided by the number released (N). It is assumed that the other three trials have the same shape of the recapture curves. Recapture rates, C/N, after one year can be read from these curves. From the function $C/N = [(1 - e^{-F}) * F] / Z$ a table of C/N and F is set up (DR, Table 12). This is used for a graph of C/N over F (not reproduced). The Fs corresponding to the (C/N)s estimated per year were read from the curve.

AVAILABLE COEFFICIENTS OF TOTAL MORTALITY

There are 11 series of herring samples from Ojaveer (1974) and one series from Rechlin (1971) in which number at age is not specifically mentioned. Graphs of catches and coefficients of total mortality were stated instead. Z was used to calculate numbers at age as shown in DR, Table 5. Fully

exploited ages are as indicated by the authors. Rechlin states Z for ages ≥ 2 . These sets indicate themselves by starting with $n=1000$ at age zero.

There are also 8 series of cod samples from Jensen (1954,1959) and one series from Stanek (1965). Jensen stated the ages for which he estimated the mortality. Z was assumed to be constant for this age range. Stanek listed the reduction between successive ages in per cent. For his data, Z was assumed to be constant from age 4 onward. The numbers shown in DR, Table 6 are calculated by means of Z .

2.2 PROBLEMS IN BIOMASS ESTIMATION

Information on yield as published in ICES Fishery Statistics (Anon.a,1906-1992) is given in DR, Tables 13-15. The data have shortcomings. For the years 1938-62, these have partly been removed by adding missing information published elsewhere (DR, Table 13). Fisheries Statistics gives a breakdown to the Belt Sea and to the rest of the Baltic. This allotment is shown in DR, Table 14 for 1903-1962, the additional data included. AWGs of ICES have collected catch statistics distributed on subdivisions. These are largely available for the years beginning 1960 and they are found in DR, Table 15.

For various reasons, some countries have not reported their catches. These are mainly Poland and Latvia for 1903-1923 and the USSR for 1938-46. The missing information is estimated on the assumption that the share of a countries catch is the same for the missing, and the reporting years just before and/or after the years for which no catches were communicated. This is done in DR, Table 16. These updated statistics are added up to the species totals and to Grand Total in DR, Table 17.

2.3 EXAMPLE OF THE METHOD.

To minimize the adverse effect of strong year-class fluctuations, the age compositions were averaged over several years. The corresponding yield has to be averaged over the same period, and it has to be weighted in the same way as mortality. As an example, $(F+M_M)$ of sprat for the years 1922-25 is considered (DR, Table 4). These years are included in the average different times:

period 1922+23	period 1923-25	period 1923-25	coverage
1922			1
1923	1923	1923	3
	1924	1924	2
	1925	1925	2

Mortality in the year 1923 has contributed three times, mortality in the year 1922 only one time. Y must be weighted in the same way as (F+MM) (DR,Table 14). We have therefore

1922	1 * 2 800 tonnes,
1923	3 * 4 300 „
1924	2 * 3 300 „
1925	2 * 2 200 „

This gives a weighted average of 3 330 tonnes.

2.4 CATCH RATES, STOCKS, AND BIOMASS CALIBRATION

CATCH RATES

Total fish catch per vessel per year is available for Poland (Laszcynski et al.1964; Morski Instytut Rybacki,1989), based on number of cutters (Polish:Kutry). For Sweden (Sahlin,1959; National Central Bureau of Statistics,1933-80) the data concern motor boats with a deck. Total biomass, based on ICES VPA estimates for clupeids and cod is at hand for the years since 1970. The Polish series of total catch rate overlaps with these data 1970-85. During this period, total biomass changed relatively little. A calibration of the Polish catch rates against this series failed therefore (DR,Figure 5). It was standardized instead by a regression between the total estimated biomass data given in DR,Table 18 and the Polish cpue giving $r = 0.88$, $n = 48$ (DR,Figure 6). The functional regression is not significantly

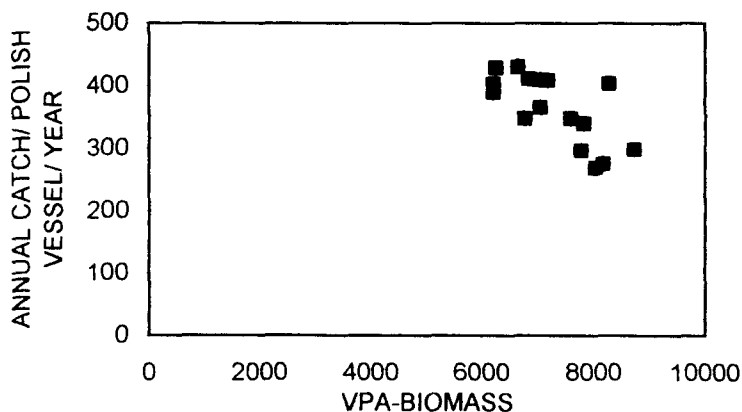


Figure 5: Total annual fish catch/ Polish vessel/ Year versus VPA-biomass of sprat, herring, cod

different from zero ($p > 0.7$). The regression was therefore forced through the origin resulting in: $\text{Biomass} = 20.44 * \text{Polish CPUE}$.

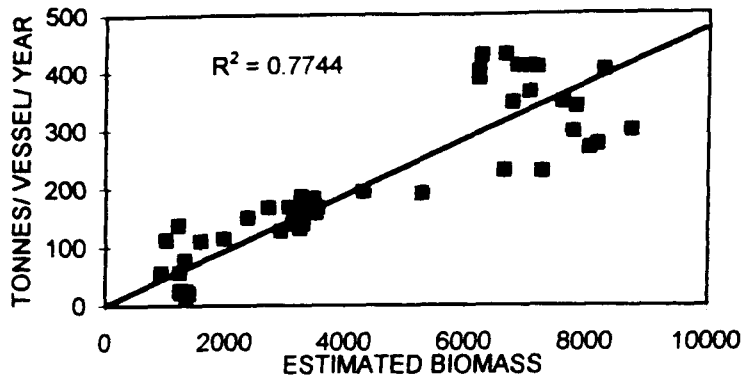


Figure 6: Polish annual catch/ vessel/ year versus estimated biomass (DR, Table 18)

The Swedish catch rate series is available until 1969. A calibration against VPA-biomass is not possible for this set neither, because there is no overlapping. For a regression with the estimated biomass data of Table 18 the variance of the Swedish cpue was stabilized by using LOG biomass instead of simple biomass. This gives $r = 0.86$; $n=35$ (DR, Figure 7). The functional regression is: $\text{LOG B} = 6.74 + 0.0092 * \text{Swedish CPUE}$. The intercept is highly significantly different from zero.

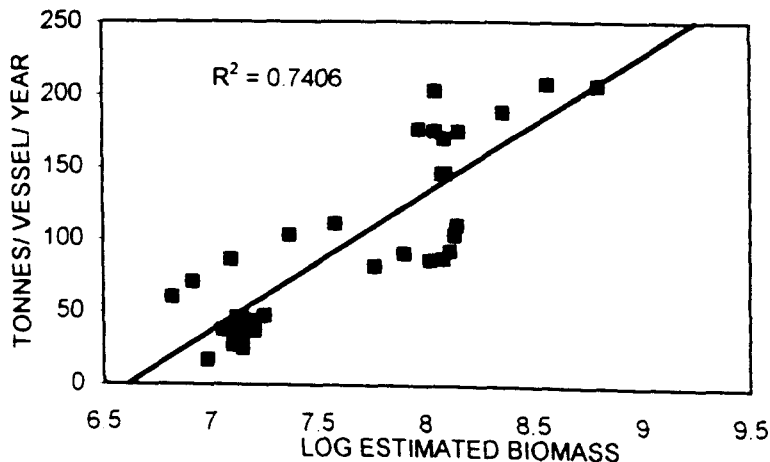


Figure 7: Swedish annual fish catch/ vessel/ year versus estimated biomass (Table 18)

Catch rate data of Steffensen & Bagge (1990) are highly significantly related to ICES VPA-biomass ($r = .76$; $p = .0002$). A predictive regression was used to estimate cod biomass in SD 22+24 for the years 1963-69 (DR,Table 19).

Calibration of the cod data in the main report meets with shortcomings. The reason is that the ICES VPA-biomass data vary very little so that no linear connexion with the $Y/(F+M)$ -values can be shown. A combined set of individual VPA-estimates of biomass for cod in sub-divisions 25-32 as shown in DR,Table 20 is therefore used to extend the biomass series backwards beyond 1970. The available biomass sets there are adjusted to ICES VPA-biomass by stepwise regression as stated in the footnotes. The series named „ICES 1987d, internal“ refers to a set published except for the years 1966-69, which were only in the computer. All regressions are significantly different from zero.

STOCKS

The AWG gives biomass for clupeids beginning 1974. For the biggest herring stock, i.e., SD 25-29+32+Gulf of Riga, and for the sprat stock, the age composition of the catches are available for 1970-73. These data, together with the published mean weights, and the coefficients of natural mortality for 1974 have been used to assess biomass for the missing years by means of a VPA (DR,Tables 21,22). The results of these estimates for herring in SD 25-29+32+G.Riga are also shown in DR,Table 23.

A comparatively low biomass for 1986 of 2.335 million tonnes is stated by the AWG (Anon.b,1992). Re-evaluation with the data of Anon.b,1992 gives a biomass of 2.838 million tonnes. This value is used here. For herring in SD 30+31 no biomass was assessed 1970-73. A regression of the biomass in SD 30+31 vs biomass in SD 25-29+32+G.Riga is significant at $p = .01$ but has an intercept of 58 331 t ($p > .4$). A functional regression was therefore forced through the origin giving:

$$\text{Biom (SD30+31)} = .0676 * \text{Biom (D25-32)} \quad (\text{DR,Figure 8}).$$

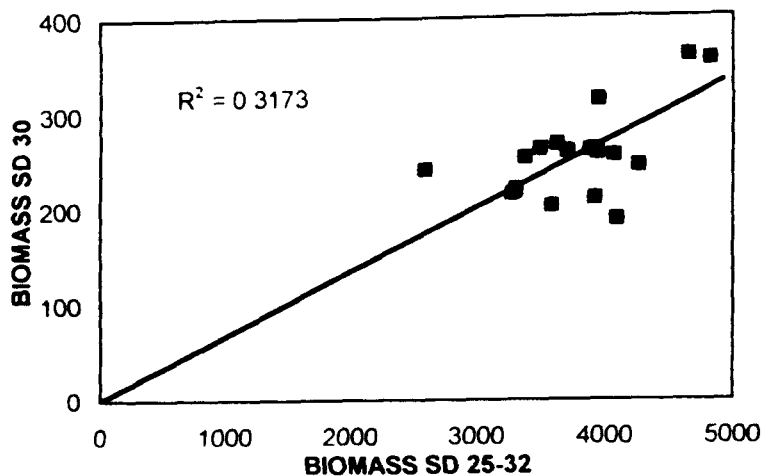


Figure 8: Herring: Biomass in SD 30+31 (B30) versus biomass in SD 25-29+32+G.Riga (Biom.25-32)

No biomass estimate concerning SD 22+24 was made for 1991 by the AWG. The value for this year was estimated here from a regression of biomass in SD 22+24 vs biomass in SD 22+24+Kattegat with data in Anon.b,1991 (DR,Figure 9).

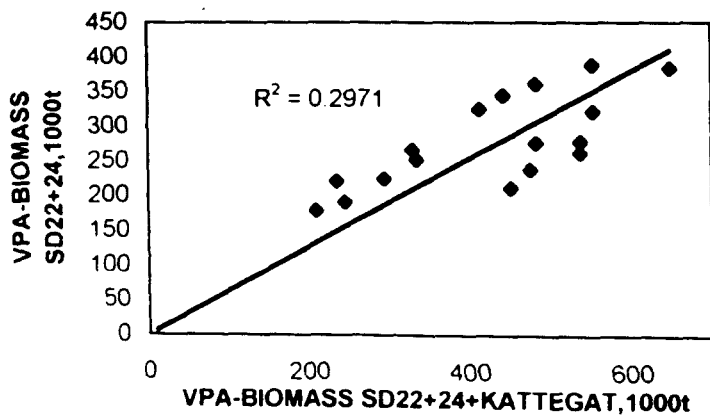


Figure 9: Estimation of herring biomass in SD22+24 for 1991 by use of biomass in SD22+24+Kattegat 1991

CALIBRATION

The data of Table 7 in the main report on cod in SD 22+24 do not enable a significant regression between $Y/(F+M_M)$ and ICES VPA-biomass because biomass remains relatively stable after 1970. Use of the catch rate series of

Steffensen & Bagge (1990) extends biomass back to 1963 (DR, Table 19). The range of these data between 1963 and 1977 is then divided into 14 periods (DR, Table 24). Even over this longer time interval, biomass varies very little so that calibration by regression is not possible.

2.5 MAMMALS

The fish consumption of mammals in the Baltic since 1900 as given in the main report is based on Durant & Harwood (1986). Their Figure 3b is simplified and divided into 6 periods of linear decrease as shown in Figure 4 of the main report. This curve of fish consumption is depicted, together with the corresponding decrease of ringed seals in DR, Figure 10.

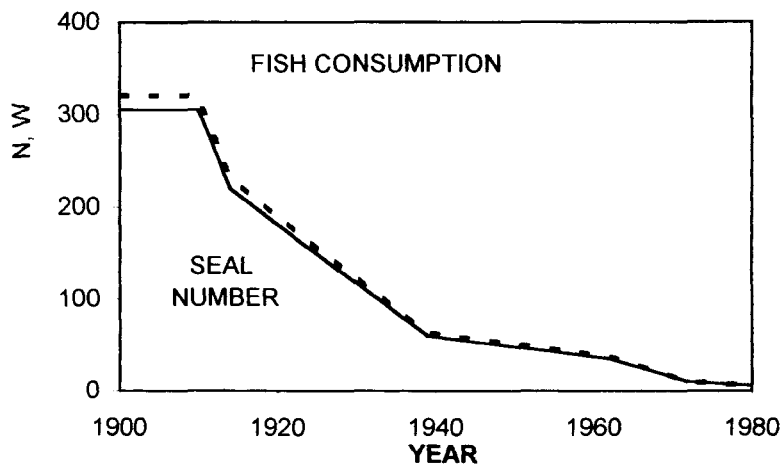


Figure 10: Number of ringed seals ($N \cdot 1000$) and weight of fish eaten by all mammals, t ($W \cdot 1000$)

2.6 RELIABILITY OF THE CATCH CURVE METHOD

A set of stock, and catch at age composition data has been constructed over 36 years to get a feeling how sensitive the estimation procedure as set out in the main report is to changes in stock size and mortality. To minimize the effect of annual fluctuations, age compositions of 3 years were aggregated as described in section 2.1 of the main report and in DR, 2.1, Pooling. This gave finally 12 sets.

Trial runs with random distribution of recruitment and mortality gave low correlations between F_{given} and $F_{estimated}$. Catches and biomasses (hence mortalities) of stocks do not show random patterns but exhibit trends in development (Daan et al. 1994; Anon. b.d, 1992). Actual recruitment data

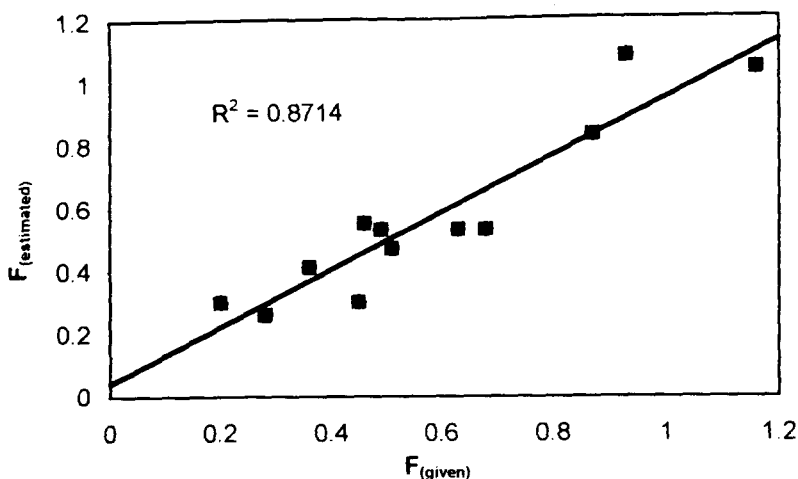


Figure 11: Reliability of the procedure to estimate F , shown by $F_{(est)}$ versus $F_{(giv)}$ from artificial data (DR, Tables 18,19)

suggest a log-normal distribution. Recruit numbers were therefore selected at random from a logarithmic scale between 7.4 and 9.9 and transformed before analysis. Z was adjusted to recruit numbers (DR, Tables 25,26).

Recruitment at age zero was simulated to fluctuate by a factor of 12, fishing mortality by 5.8. This is compared with the changes shown for the most important stocks in the Baltic during 1970-1991.

	R	F
Artificial stock	12	5.8
Herring,SD 25-29+32+Riga Gulf	4	2.4
Cod,SD 25-32	14	2.4

The crucial point in this analysis is the agreement between F_{est} and F_{giv} . Their correlation is significant at $p < 0.00001$ with $r = 0.933$. The intercept of the regression (0.04) is small and not significantly different from zero, and the slope (0.91) is not significantly different from 1 (DR, Figure 11).

The method reacts to changes in mortality with a delay. The reason would be that the slope over Log n of those ages which had already been present in the preceding set (i.e., 3 years earlier) would remain approximately constant compared to the slope of the same year-classes 3 years earlier. To show this, the slope of LOG catch for ages ≥ 4 was correlated with the slope of LOG catch for the same year-classes 3 years earlier (DR, Figure 12). This results in a highly significant correlation with the plots deviating little from the regression line. The overall result is a slow reaction of F_{est} to changes in the fishery. The method will therefore produce an adequate picture of trend developments but not of short-term fluctuations.

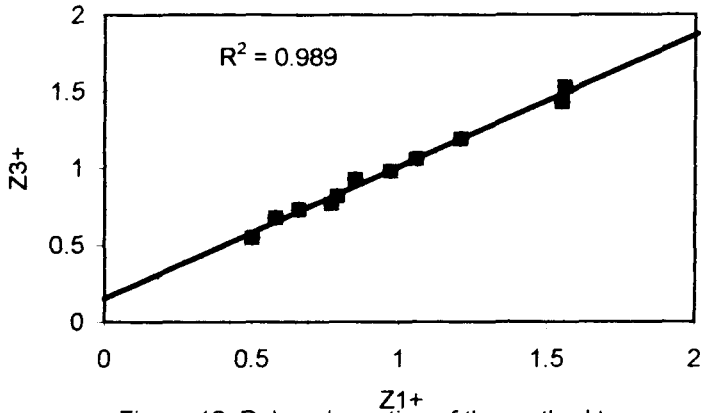


Figure 12: Delayed reaction of the method to changes in mortality, shown by a plot of Z for ages left after 3 years ($Z3+$) vs Z of the same yearclass 3 years earlier ($Z1+$)

4. THE EFFECT OF MAMMALS

Data of Jensen (1927) suggest that the density of herring in the Bornholm region was rather stable 1910-18 and decreased thereafter (DR, Figure 13).

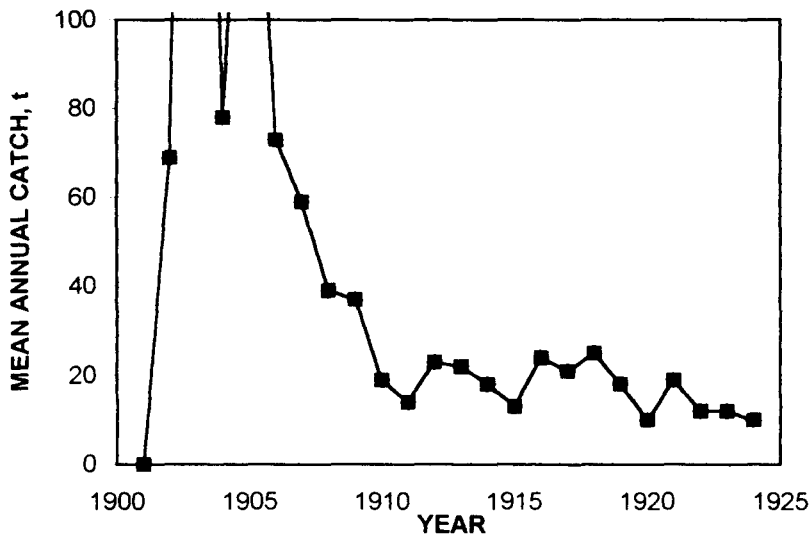


Figure 13: Catch of herring/motorboat/year, tonnes

The author published annual catches and the number of motorized vessels 1901-24 in a graph from which the data in DR, Table 27 were read. No split in engined, and sailing vessels was stated. The catch per motorboat per year was very high during the first decade. By 1910, the catch rate stabilized.

Before 1902, the whole catch was achieved by non-motorized vessels. When the first engines came to be used, the catch per motorvessel was apparently very high. The reason is that the catch rate had to be computed from the total catch, that of non-motorized vessels included. Clearly, these first catch rate data are biased. Since 1910, however, they adjusted to a stable level. It is therefore assumed that the catch per vessel per year as shown here for 1910-24 is a fair indication of stock density of herring.

For this time interval, the data were divided into 2 periods, 1910-19, and 1920-24. A two-sample analysis showed that their mean catch rates, 19.7 t/y, stand.dev.=4.05 (1910-19) and 12.6 t/y, stand.dev.=3.71 (1920-24) are significantly different at $p < 0.05$.

5. FINAL BIOMASS, B

VPA-biomass of the main species, sprat, herring, and cod is largely available since 1970. These ICES assessments are used in the same way as the estimated biomasses to evaluate a total biomass by assuming that the average Y/B for all species is the same as for the mean of clupeids and cod. Total yield (DR, Table 17) divided by the average Y/B (DR, Table 18) gives the total biomass based on VPA (DR, Table 18).

B. DATA REPORT TO: „ESTIMATION OF SOME FISH SPECIES' BIOMASSES IN THE BALTIC SEA DURING THE 20TH CENTURY“

6. INTRODUCTION

In the report on total fish biomass it was stated that estimation of species biomasses needs knowledge on the fish species consumption of mammals. This information was collected in the above report. Data used can not all be published in the main report. They are shown here.

7. DATA ON SEALS AND THEIR FOOD

The available data on food of Baltic seals are mainly from Söderberg, 1975 and from Tormosov&Rezov, 1978. They concern numbers of prey eaten. To express these numbers in terms of weight, mean prey weights in harbour seal and porpoise were used (Table 28). These weights have mainly been arrived at by conversion of length into weight (Table 29).

It was assumed then that the mean weight of prey of grey seals is greater than that of ringed seals by an amount corresponding to their daily fish consumption. The mean daily fish consumption of mammals is given by Elmgren (1989): grey seal 3.2 kg, common seal 2.1 kg, ringed seal 1.7 kg, and harbour seal 1.8 kg. At first the evaluated prey size of porpoise was converted to that of harbour seal by $2.1/1.8 = 1.1667$ (Table 30). Prey weights of harbour seal were then adjusted to grey, and ringed seal. Finally a simple average of all ascertained weights of each specified prey has been computed.

These mean weights were then multiplied by the numbers of prey eaten by 100 predators. The resulting weights for grey, and ringed seal should be in approximately the same proportion as the weights of their meal sizes. Table 31 shows this to apply to Söderberg but not to Tormosov&Rezov.

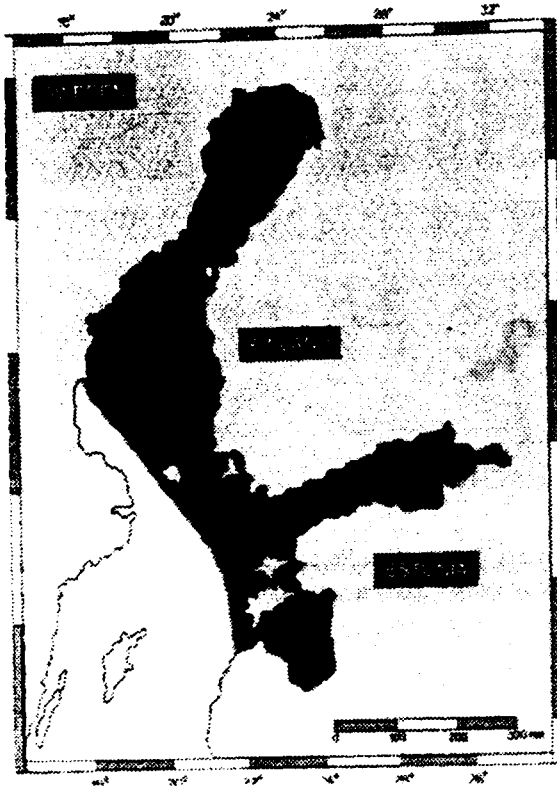


Figure 14: Distribution of ringed seal (Härkönen,1992)

It has to be decided, however, if and in which way both data series should enter the evaluation of consumption rates. Firstly, ringed seal is largely distributed in the Gulf of Bothnia (Figure 14), a smaller part in the Gulfs of Finland, and, Riga. Secondly, grey seal is found in the whole Baltic (Almquist et al.,1980). The north-eastern population investigated by Tormosov&Rezovov would contribute even less to the total of grey seals than the corresponding fraction of ringed seals to their total, Furthermore, taggings suggest that the north-eastern grey seals do not stay apart but intermingle with the populations in other regions (Almquist et al.,1980). Finally, the proportions of the fish weights eaten by grey, and ringed seal in the northeast is so different from the expected value that this information can be given very little weight. It will enter the estimate, however, because of the difference in prey composition of both investigations. This is done by use of weighting factors 0.9 for Söderbergs and 0.1 for the data of Tormosov&Rezovov. Finally, an average for ringed, and grey seal is calculated by use of weighting factors 0.7 (ringed s.) and 0.3 (grey s.) according to their earlier abundance (Elmgren,1989).

8. ESTIMATED BIOMASS

Biomass estimates for periods are shown in Tables 32-35. The difference between Y_1 and Y_2 is simply that Y_1 is a weighted mean (Thurow,1997), Y_2 not. Bu_1 for the early period is found from the correlation of Bu_1 versus Y_2

(Figure 15). The intercepts of all regressions are not significantly different

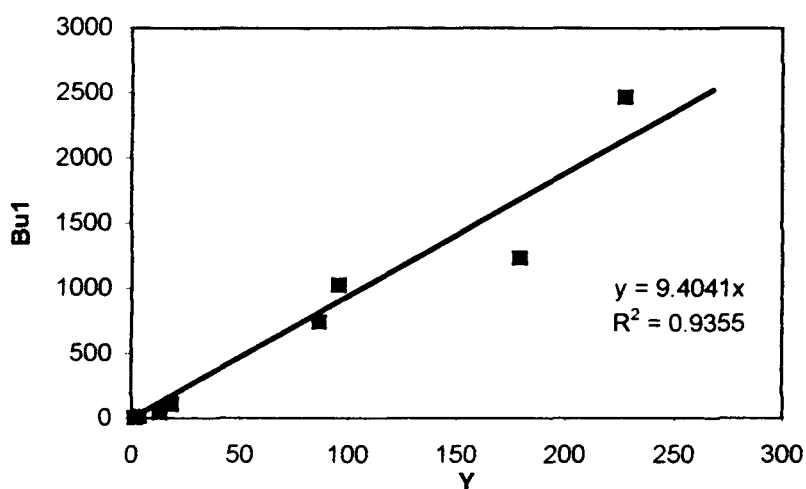


Figure 15: Sprat: Bu1 v Y

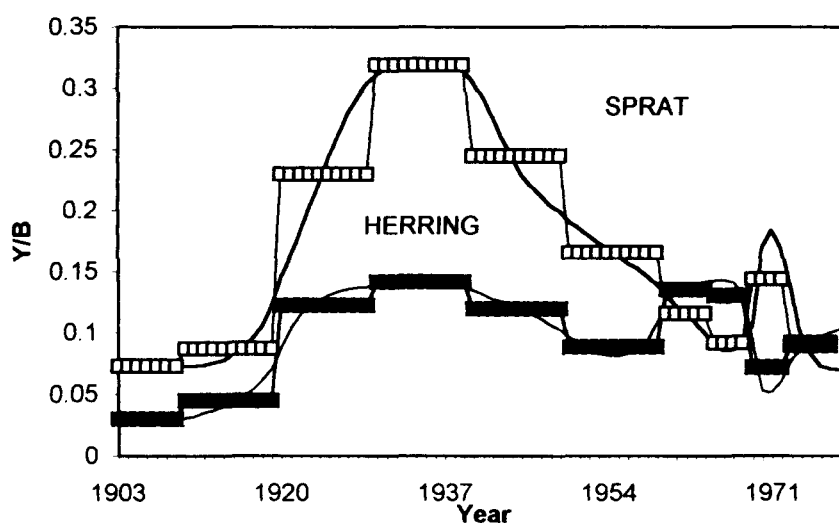


Figure 16: Fishing mortality, Y/B, of sprat and herring, for periods and interpolated over years

from zero. They are therefore forced through the origin. Note the difference between $\Delta C'$ and ΔC according to formulas (1) and (3) of the main report. The estimations of all other quantities bear out from the tables.

To estimate annual biomass from annual yield and weighted annual fishing mortality, $\bar{F} = Y/B$, the latter has to be evaluated. This is done by interpolating between their means for periods (Figures 16+17).

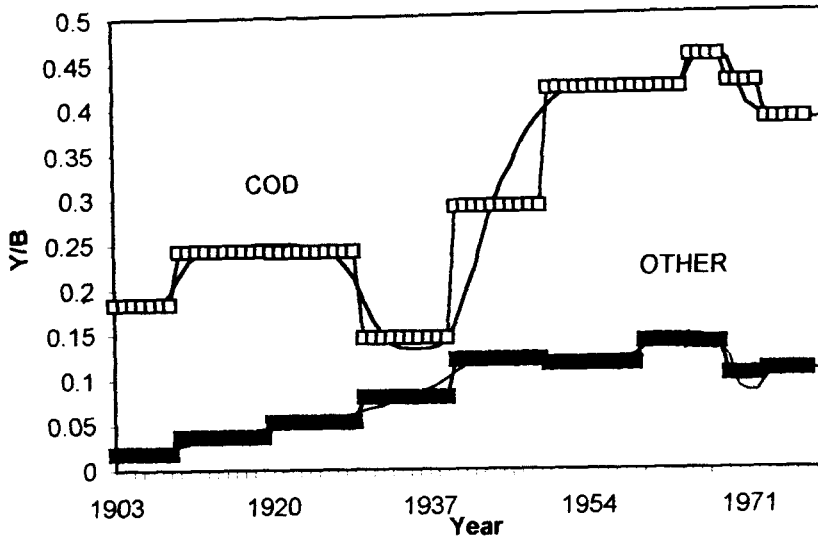


Figure 17: Fishing mortality, Y/B , of cod and of other species for periods and interpolated over years

The annually estimated-biomasses resulting from $Y/[\bar{F}=(Y/B)]$ are listed in Table 36.

9. CATCHRATE-BIOMASS

Catchrates used to estimate biomass are shown in Tables 37, 38, 39, and 40 for sprat, herring, cod, and species other than these. Some of these series have been used by U. Damm with the ICES- RCT3 computer programme to calibrate them against VPA-biomasses of ICES. The method applies log/log regressions.

We would expect now, that the catchabilities evaluated by this method ($q = \text{cpue}/B$) exhibit an increasing trend over the years. Unfortunately, q estimated this way, behaves just the other way around. If, instead of log/og however, a logarithmic regression is chosen, biomass versus log cpue that is, then the tendency to have higher cpue and lower q for the early years will be achieved. This method was used alternatively to show how good these catchrate-biomasses match the estimated-biomass.

The Swedish catchrate series cannot readily be used for calibration purposes, because they display only 2 values for the reference period after 1969. To be able to use them, they were functionally regressed (log/log) to the Polish data (Figure 18). With the completed years the sets can be used as predictors for catchrate-biomass. This procedure was not possible for species other than sprat, herring, and cod, because the Polish, and Swedish sets vary in different directions.

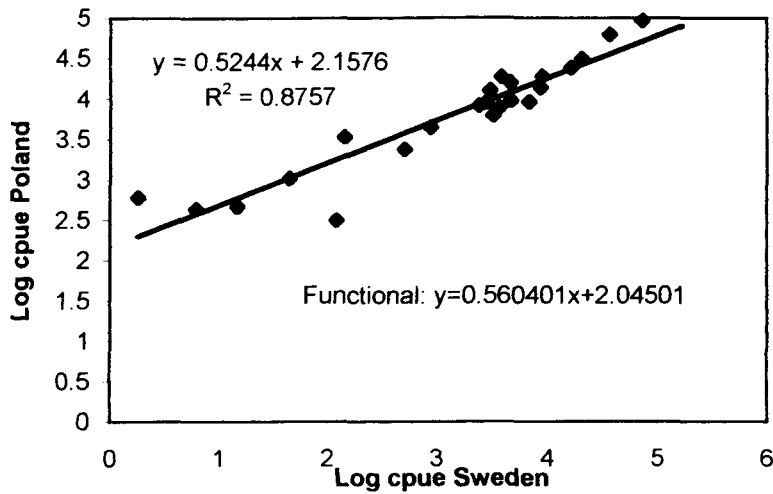


Figure 18: Herring: Log cpue Poland v log cpue Sweden

To complete the evaluation of catchrate-biomass of **sprat** for the early years, the biomass corrected for catchability was regressed to log yield for the period 1921-36 (Figure 19) and biomass estimated for 1903-20. The results are also

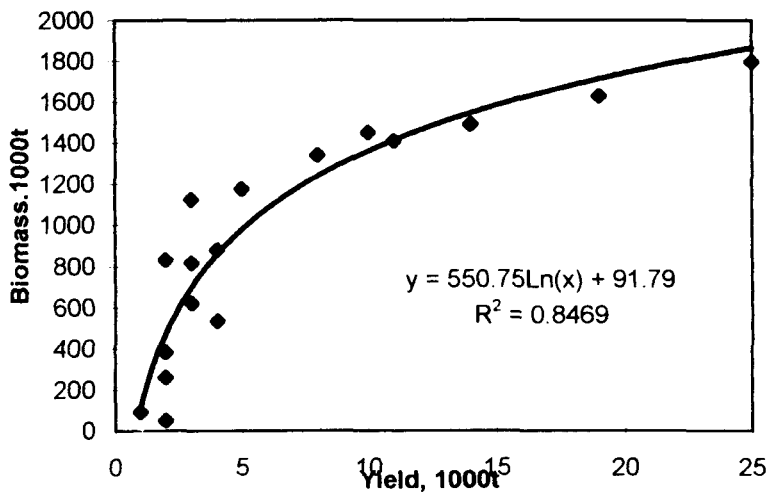


Figure 19: Corrected catchrate-biomass v yield of sprat

shown in Table 41 together with the outcome of other manipulations.

Opposite to sprat, the catchrate-catchability of **herring** is shown to be very high in the beginning of the 30s with a declining trend thereafter (Figure 20).

In the same way as for sprat, VPA-biomass is therefore regressed to $\log(\text{cpue})$. In the same way as for the log/log relationship, the slope is slightly negative and the regression is therefore forced through the origin (Figure 21). A new catchrate-biomass is then computed which displays the same trend, and is on the same level as the estimated-biomass (Figure 22).

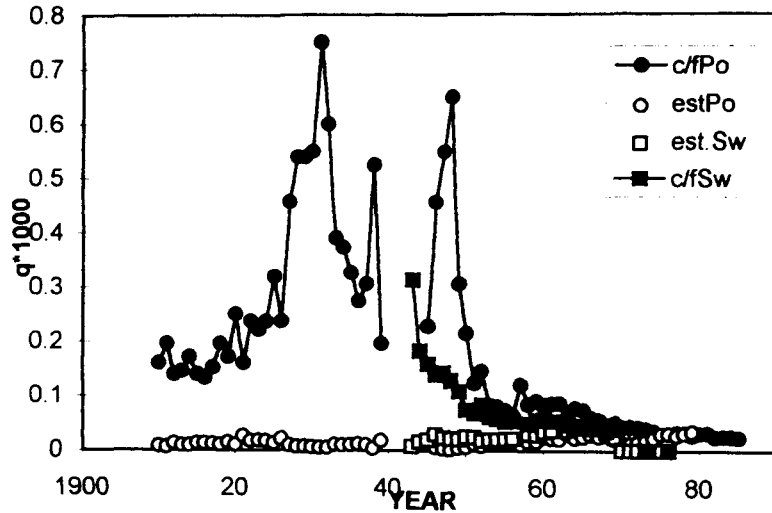


Figure 20: VPA, estimated, and catchrate-catchability of herring, based on Polish or Swedish effort

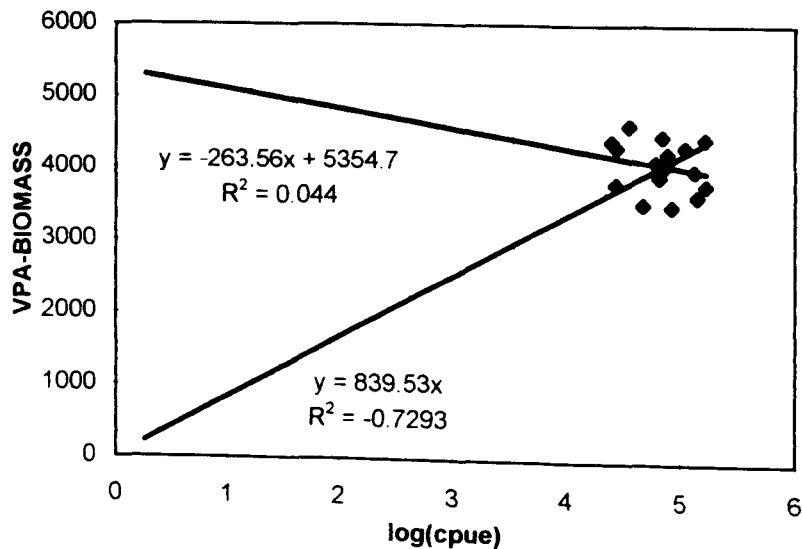


Figure 21: Herring: VPA-biomass v $\log(\text{cpue})$ Poland

New catchabilities are then calculated (Figure 23). Estimated- q displays strong variations, catchrate- q not so. But both series suggest that catchability showed no clear trend during the first half of the century and that it increased enormously since the end of the last war.

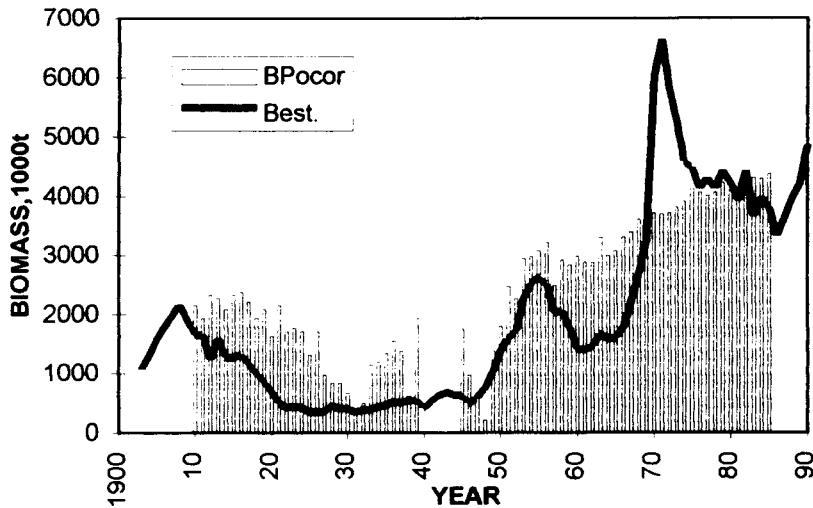


Figure 22: Estimated-biomass and Polish catchrate-biomass corrected for catchability

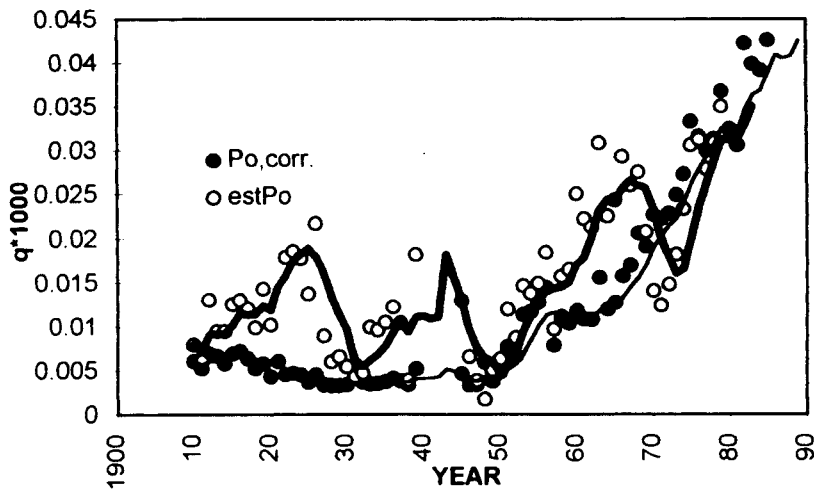


Figure 23: Estimated- and corrected catchrate-catchability, based on Polish effort

All data and results are shown in Table 42.

In Figure 24, catchrate-catchability of cod is shown to decrease in time whilst estimated-catchability based on Polish effort rises. As for herring, this suggests that estimated-biomass tends to be more reliable than catchrate-biomass. In particular, estimated-catchability displays insignificant variation 1925-40. Thereafter, it rises significantly by 13% until 1948, whilst it decreases slightly but significantly in the following years (Figure 25). The same bears out if q is based on Swedish effort

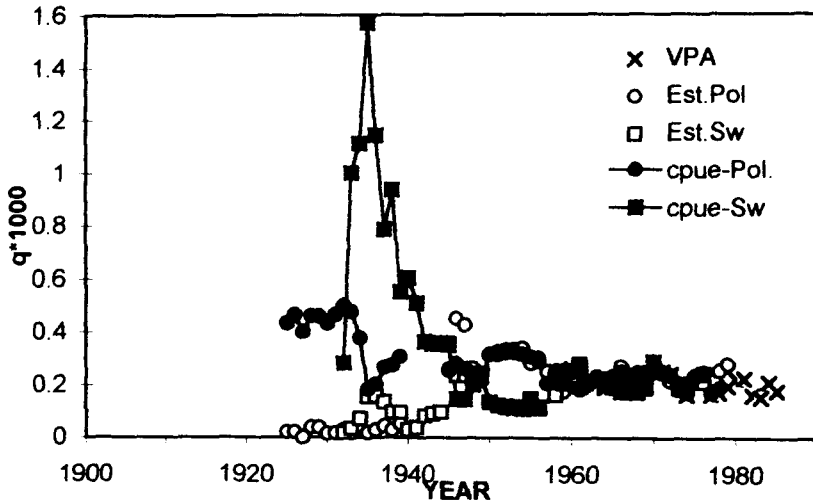


Figure 24: VPA, estimated, and catchrate-catchability of cod, all based on Polish, and Swedish effort

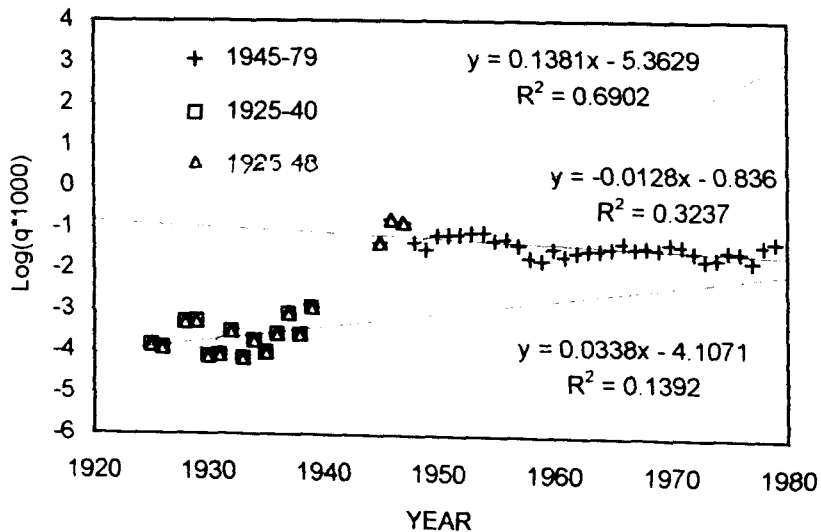


Figure 25: Log estimated-catchability of cod, based on Polish effort

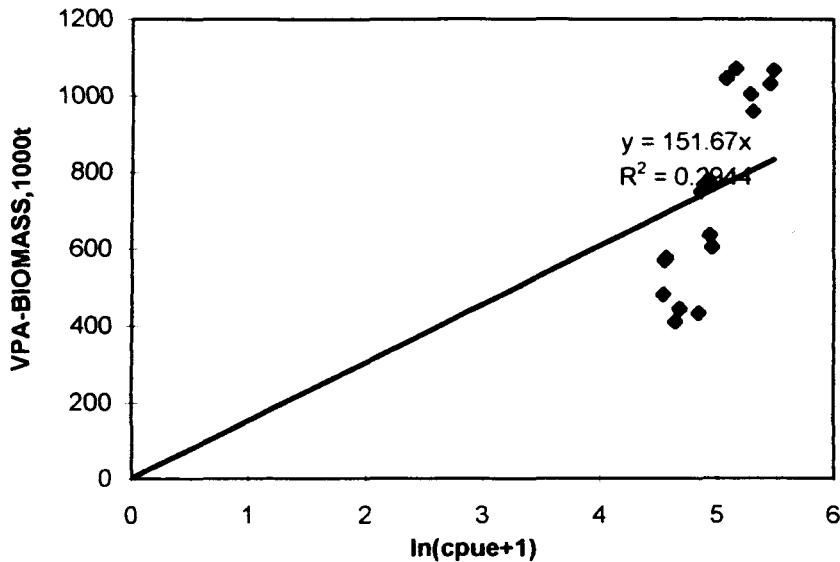


Figure 26: VPA-biomass v log(cpue)Poland

If the catchrate-biomass is evaluated from VPA-biomass v log(cpue) of Poland (Figure 26), the resulting biomass fits the estimated-biomass nicely for 1920-40 but subsequently too high biomasses bear out (see main report). This simple procedure of correction for cod does therefore not work. A differential change in efficiency, in a way as displayed in Figure 25 would have to be used in order to adjust the catchrate-biomass. The biomasses and catchabilities of cod are set out in Table 43.

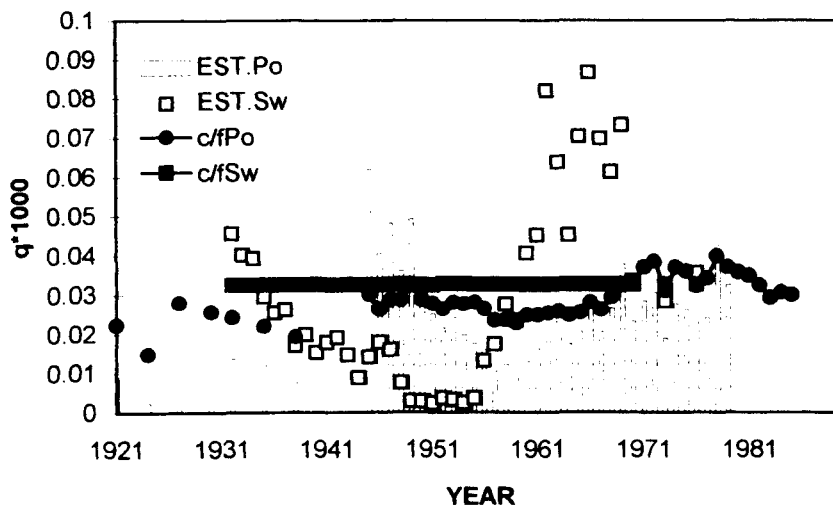


Figure 27: Estimated, and catchrate-catch-ability of "Other" species, based on Polish, and Swedish effort

Catchabilities of species **other** than sprat, herring, and cod are displayed in Figure 27. The Swedish series fluctuates wildly or is constant. The Polish qs, on the other hand, show increasing trends with the least variance about the trend in the catchrate-catchability ($p<0.001$). This bears out from the comparison of Figures 28, and 29. The Polish based series shows itself to be the best indicator for the increase in efficiency. Biomasses and catchabilities are listed in Table 44.

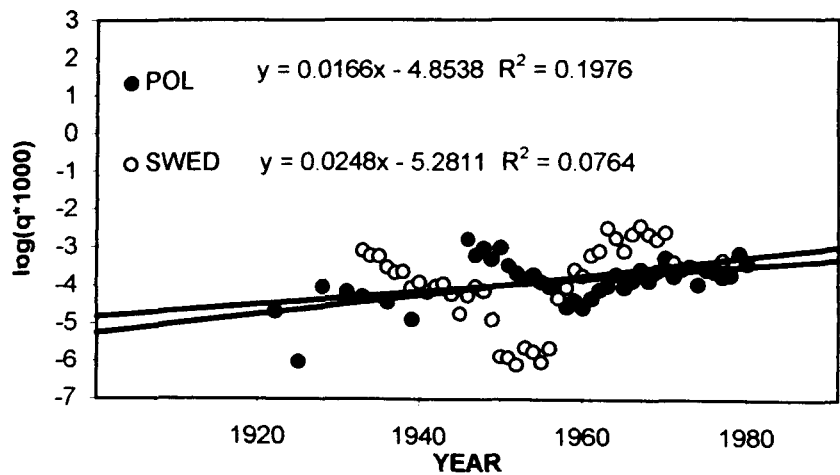


Figure 28: Estimated-catchability of "other"species

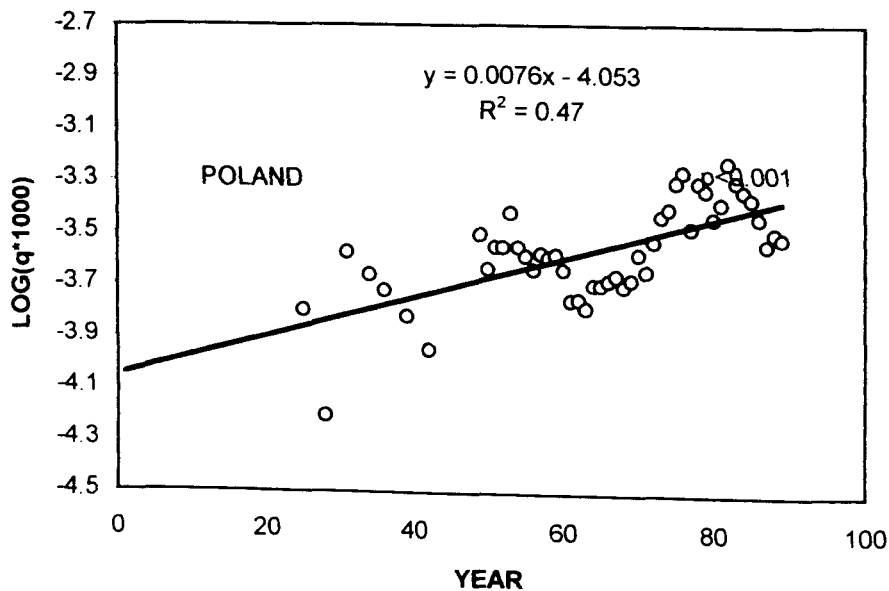


Figure 29: Catchrate-catchability of "other"species

10. YIELD AND FISHING MORTALITY, $\bar{F} = Y/B$

The catchrate- \bar{F} ($=Y/B$) of sprat (corrected for outliers between 1938 and 1955) and the (smoothed) catchrate-biomass are used for an improved estimate of the yield of sprat, Y_2 , which is tabulated in Tab.41 and depicted in Figure 30.

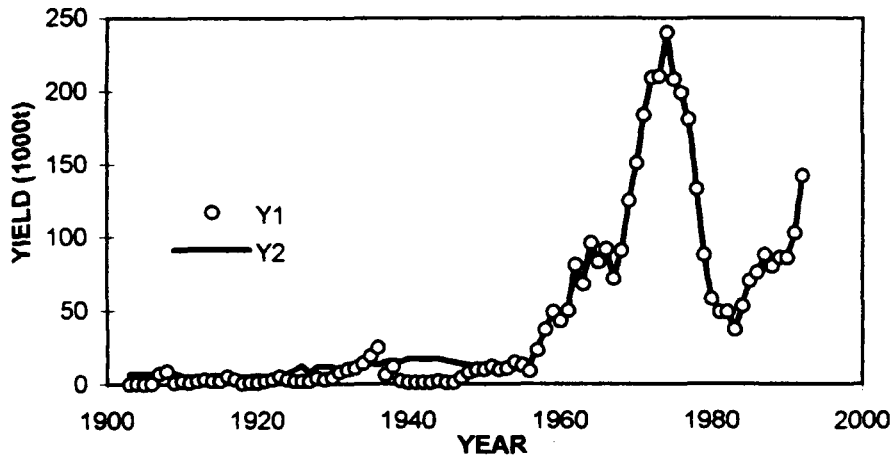


Figure 30: Original yield (Y_1) and corrected yield ($Y_2 = F_2 \cdot B$) of sprat

The estimated- \bar{F} and the catchrate- \bar{F} of species other than sprat, herring, and cod differ quite substantially (Figure 31)

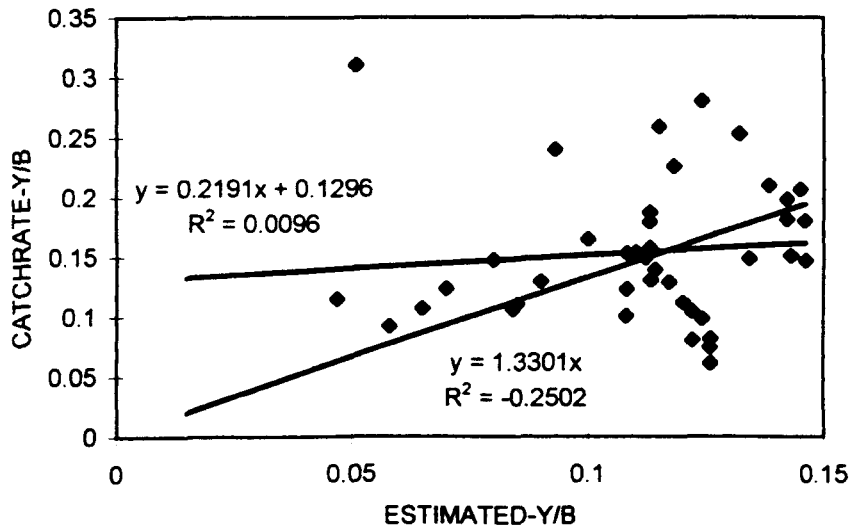


Figure 31: Catchrate-Y/B(Poland) over estimated-Y/B

11. RECRUITMENT ESTIMATES

F_{1-7u} over \bar{F} for sprat is depicted in Figure 32 (Table 41). The values of F_{1-7u} stem from Anon.1992/Ass.13. The plots for 1990,91 have been omitted as these last estimates are not very reliable. The exercise indicates that $F_{0.1} \sim 0.5$ corresponds to $\bar{F} \sim 0.3$.

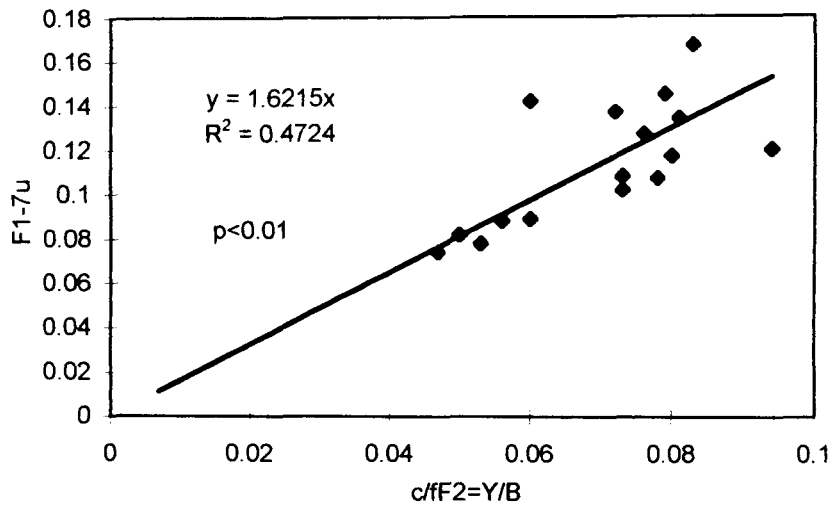


Figure 32: Sprat: F_{1-7u} v \bar{F} (DR, Tab.41)

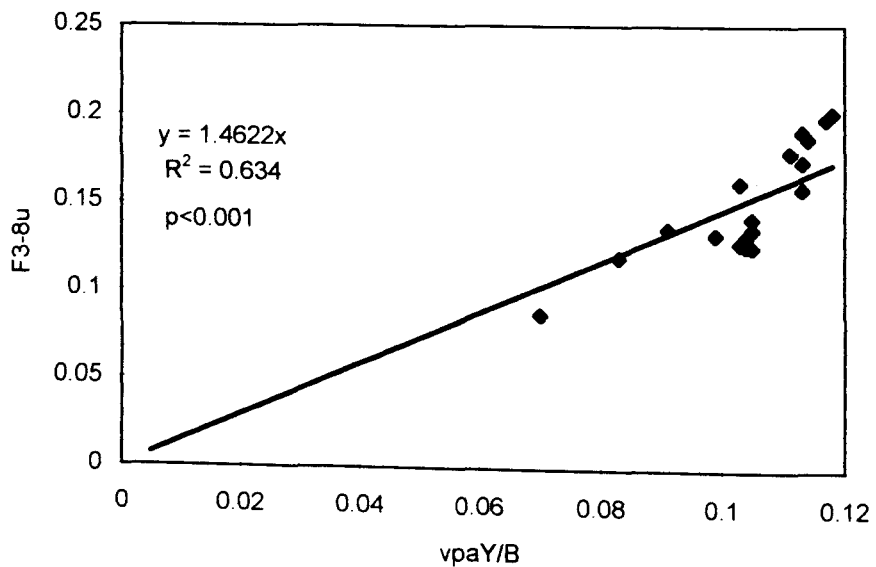


Figure 33: F_{3-8u} of herring v $vpaB$

Figure 33 (Table 42) shows F_{3-8u} of **herring** over $\bar{F} = Y/vpaB$, both series smoothed. The first stems from 1992b/Ass 13,p.36 and concerns subdivisions 25-29,32+Gulf of Riga. The other is made up of the data in DR,Table 17 and Thurow,1997, Table 4. The Assessment WG has made recruitment estimates for the large stock in subdivisions 25-29+32+G.Riga, being largely representative of all Baltic herring (1989b/Ass.14,p.245). This suggests that $F_{0.1} \sim 0.2$ and $F_{max} \sim 0.7$. These values correspond to $\bar{F} \sim 0.15$ and 0.5 .

The regression of F_{4-7} of **cod** versus $vpa(Y/B)$ is displayed in Figure 34 (Table 43). F_{4-7u} is about 2 times greater than $\bar{F} = vpa(Y/B)$. Figure 35 shows yield per recruit versus \bar{F} of ICES VPA-data (Anon.1992d/Ass.12)

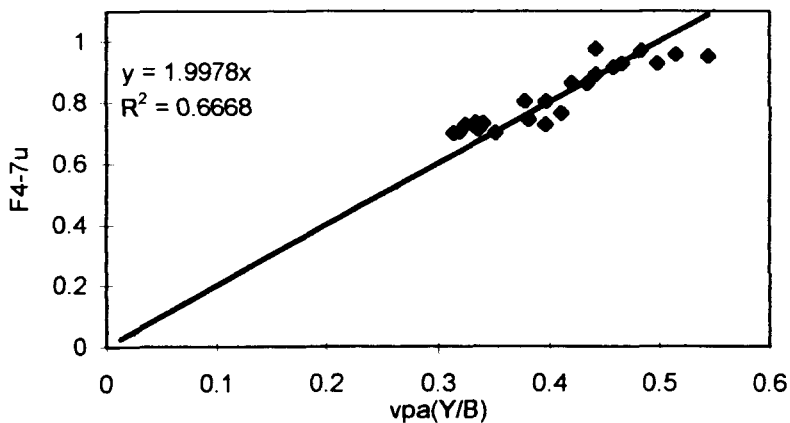


Figure 34: Cod: F_{4-7u} v $vpa(Y/B)$

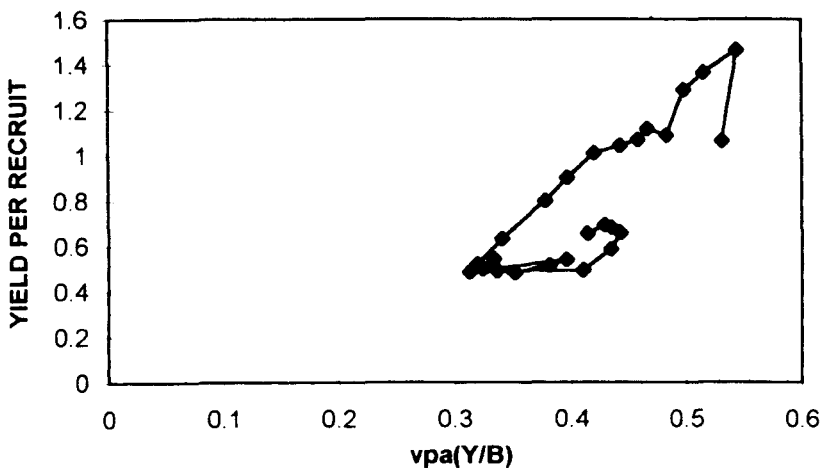


Figure 35: Yield per (VPA)recruit v $vpa(Y/B)$ (both smoothed) of cod

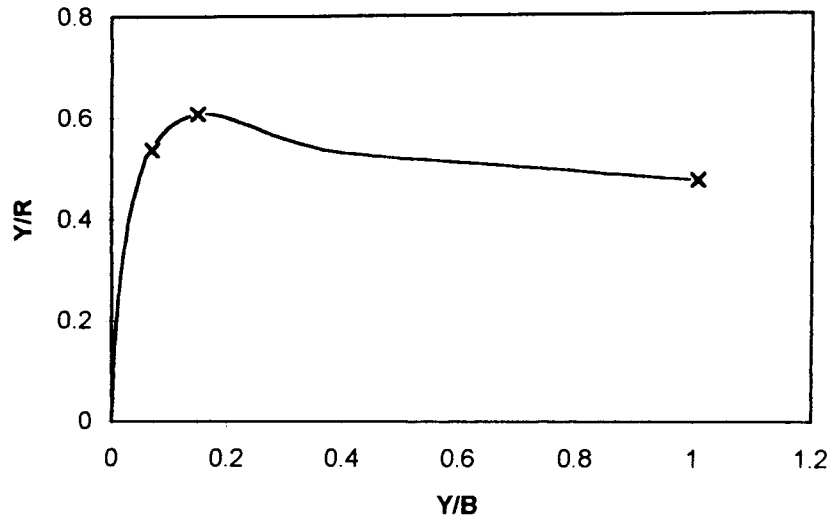


Figure 36: Y/R over Y/B of cod, handdrawn

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Table.1: Coefficients of age specific natural mortality, cod predation (M_c) and residual (M_R), for the period before 1977. The values were arrived at by smoothing and extrapolating those published in Anon.b, 1991 (DR, Figures 1+2). These were then converted from the average of the period 1974-89 (e.g., 0.543 for sprat) to the average of the periods 1974-77 and 1986-90 (e.g., 0.500 for sprat). Figures 1+2 have been used to downgrade (M_c+M_R) to the lower level.

	AGE										
	0	1	2	3	4	5	6	7	8	9	10
Before 1977, Herring, SD25-29,32	.91	.56	.36	.32	.29	.27	.25	.24	.23	.23	.23
" " Sprat, SD 22-32	1.10	.91	.72	.56	.43	.40	.40	.40	.40	.40	.40
" " Herring SD 22+24	-----					.30	-----				
" " " SD 30	-----					.20	-----				
" " " SD 31	-----					.15	-----				
" " Cod, SD 22-32	-----					.20	-----				

Tab.2: Weight at age(g) used to weight ($F+M_R$) by $N \cdot w$. The values are arrived at by selection of the lowest weights in Anon.b,d,1991 and their smoothing.

Age	Cod in SD		Herring in SD		Sprat in SD
	22+24	25-32	22+24	25-32	
0	1	1	1	1	1
1	40	10	10	7	6
2	400	100	30	19	10
3	800	400	70	32	12
4	1 300	900	95	42	13
5	2 000	1 300	115	51	14
6	3 000	1 800	130	58	14.4
7	4 100	2 500	135	64	14.6
8	5 400	3 200	140	68	14.8
9	6 900	4 000	145	72	15
10	8 500	4 600	145	74	15
11	10 000	5 200	145	74	15
12	11 000	5 800	145	76	15
13	12 000	6 100	147	77	15
14	12 500	6 300	147	77	15
15	13 000	6 500	147	77	15

Table 3: Number of successive years over which catch at age is pooled before Z is estimated by the Catch Curve Method

Pooled Years	Sprat	Herring	Cod
1	11	15	9
2	17	27	3
3	40	55	18
4	1	19	25
5	2	35	36
6			3
7		3	2
8			
9			
10		1	
En	71	155	96
mean number of yrs	2.5	3.3	4.0

Table 4: Number at age for the estimation of $(F+M_w)$ in sprat. Estimates of $(F+M_w)$ are based on ages ≥ 1 .

Author	Sub-div.	0	1	2	3	4	5	6	7	8	9	$(F+M_w)$	Period
Hessle, 1927a	27		119	1650	4176	2272	618	144	22			.39	1922-25
"	27		194	1253	1214	301	39					.53	1923-25
"	27		4519	2084	2274	285	38					.61	"
Dixon, 1932	26			132	4440	2165	158					.49	1931+32
" 1937	26			46	333	544	76	1				.84	1934-36
" 1934	26	42	495	1145	291	21						.84	1935-37
Meyer, 1942 ¹	26			527	583	771	118					.51	1935-36
"	22			436	644	1053	548	40	4			.50	1935-37
"	22			670	432	1255	655	48	1			.71	1937-41
Kändler, 1939	22	44	2891	556	248	10						.93	1938-39
Meyer, 1942 ¹	26			177	268	1158	433	15				.60	1939-41
"	24			506	916	2362	675	17				.59	"
"	22				47	59	10	2				.42	1940+41
Morawa, 1955	22		2123	396	238	26	2					.82	1951+52
"	25		14	162	32	6	2					.55	"
"	26		648	774	347	78	14					.52	1951-53
Elwertowski, 1957	25		147	341	412	788	828	484				.08	1953-55
"	26	289	743	358	317	227	66					.07	"
"	26		368	374	217	280	605	156				.30	1954-55
"	26	182	1511	4815	3127	1681	535	146				.20	1955-59
"	25	68	292	2545	2659	1029	221	88				.34	1957-59
Rechlin, 1979	26		58	155	354	683	982	547	183	35	3	.32	1964-66
N.N., 1967	24		8	10	8	35	132	133	46	15		.20	1965
"	25		7	4	80	238	521	107	34	9		.30	"
"	28		45	59	92	304	384	89	27			.29	"
"	24			14	17	57	148	345	259	112	48	.14	1966
"	25			16	37	25	121	354	384	31	32	.19	"

Table 4 continued:

Author	Sub- div.	Age									Period	
		0	1	2	3	4	5	6	7	8		9 (F+M _w)
N.N., 1967	25			27	75	43	238	370	206	32	9 .25	"
"	25			88	164	188	206	218	97	28	11 .21	"
"	28			116	130	91	264	180	164	46	9 .24	"
"	28			85	148	149	265	208	113	30	2 .31	"
Rechlin, 1979	29		328	574	236	582	415	542	206	91	22 .16	1967-69
Seletskaya, 1970	26		133	1043	303	293	169	51			.12	1968+69
"	28		138	944	344	265	240	60			.11	"
Polivaiko, 1972	25		121	256	633	856	916	183	37	18	.30	1969-71
"	26		84	1069	955	507	300	71	13	1	.39	"
"	28		48	544	985	673	582	140	22	6	.34	"
Rechlin, 1979	29		128	109	855	840	719	191	76	38	22 .16	1970-72
Aps, 1986	≥26	8	717	612	894	738	423	299	66	48	18 .19	1970-73
Graumann, 1975	25		259	88	130	455	822	233	13		.35	1972+73
"	26		212	344	572	516	325	31			.40	"
"	28		181	204	197	629	435	57			.34	"
Sjöblom, 1975	≥29		156	694	163	213	237	287	88	45	31 .14	1974
"	≥29		201	759	170	232	188	290	108	17	13 .23	"
Rechlin, 1979	29		351	452	727	431	417	399	162	40	15 .22	1973-75
Lindquist, 1979	25		1305	1756	1073	1476	358	95	139	87	9 .20	1976+77
"	26		2054	3783	1494	1832	266	83	165	87	9 .16	"
Lindquist, 1979	28		2759	5326	1259	2400	278	215	275	87	6 .17	1976+77
"	29		840	3994	719	1342	307	243	137	38	9 .16	"
Rechlin, 1979	≥25		358	770	582	603	375	109	78	44	23 .16	1976-78
Aps, 1986	≥26	9	112	740	761	717	239	157	128	47	23 .09	1977-79
Sjöblom, 1981	≥29	7	220	194	358	1176	1435	1319	469	222	169 .14	1979-81
" 1983	"		19	31	62	652	670	800	174	190	135 .07	1979-81
" 1984	"	50	1016	545	189	929	985	907	250	143	123 .13	"
Aps, 1986	≥26	17	491	901	260	137	559	285	172	92	42 .11	1980-82
Sjöblom, 1985	≥29	42	151	964	899	766	234	219	1104	863	499 .07	1982-84
" 1986	"		4	<u>214</u>	<u>158</u>	<u>219</u>	<u>53</u>	<u>45</u>	589	655	671 .02	1982-84
" 1986	"	143	391	<u>1610</u>	<u>1171</u>	<u>794</u>	<u>212</u>	<u>106</u>	627	436	308 .14	"
Aps, 1986	≥26	37	633	738	<u>818</u>	<u>308</u>	<u>179</u>	<u>33</u>	19	122	42 .20	1983-85
Hagström, 1990	24	7030	2567	1227	950	415	145	45	31	9	5 .17	1984-86
"	25	1229	3020	2895	2573	1977	734	256	162	88	36 .14	"
"	26	2569	1587	1977	2987	2337	1468	582	328	244	119 .10	"
"	27	421	1856	5243	3647	2312	648	376	296	189	98 .10	"
"	28	853	2661	5440	4854	2631	1536	447	326	177	120 .14	"
"	29	382	2420	3797	2748	1492	612	380	165	83	47 .14	"
"	24	5390	2226	907	413	243	82	33	15	6	1 .18	1987-89
"	25	1033	1797	1641	1766	1354	1397	641	271	97	19 .22	"
"	26	599	1649	1288	1871	2567	2803	1916	931	295	99 .18	"
"	27	2775	2034	1589	2079	1938	1462	595	222	85	28 .22	"
"	28	903	2457	2215	4293	3902	2683	1266	454	125	33 .25	"
"	29	1184	3309	1376	2551	958	692	240	59	29	4 .22	"

¹ Converted from length distributions acc.to length-age key of Dixon(1932), see DR, Table 7.(F+M_w) Average coefficient of Mortality weighed by biomass at age from age 1 to the age with <.5 fish.

Underlined are ages selected for mortality estimates if not all fully recruited ages were used.

Table 5: Number at age of herring and (F+M_w) estimated thereof. Estimates of (F+M_w) are based on ages ≥1. For (M_c+M_w) see DR, Tab.1.

Author	Sub-div.	Age										(F+M _w)	Period
		0	1	2	3	4	5	6	7	8	9	10	
Henking ¹ , 1920-22	22		867	5323	4431	461	89	25	3			.97	1920-22
Altnöder, 1928	22		328	765	734	132	61	7	2			.70	1925-27
Meyer ² , 1942	22	1115	1646	2298	546	84	23	1				1.11	1935-37
"	24	2135	1175	2818	1796	1964	722	219	64			.48	"
"	22	380	612	3119	566	24	3	1				1.19	1938-41
"	24	1424	1894	4705	2605	2120	667	215	62			.48	"
Blegvad, 1943	24			27	31	15	9	10	4	1	2	.20	1938-41
Jensen, 1948	24			4	14	12	11	12	33	13	1	.33	1946
"	24		5	37	21	18	4	3	8	4	1	.10	"
Neb, 1970	22			22	17	70	32	5				.52	1949+50
Brandhorst, 1955	22			5	181	89	38	21	6			.42	1953
Neb, 1992	22			27	194	180	147	39	18	6	2	.36	1954-56
"	22			28	337	316	229	76	43	9	4	.36	1954-58
"	22			56	508	296	259	82	34	8	3	.39	1955-59
"	22			29	345	187	123	50	27	4	2	.37	1957-59
Rechlin, 1967	22	8	127	125	152	55	20	10	5	3		.40	1963-67
"	24		15	48	80	113	104	67	40	20		.17	"
N.N., 1967	22	623	943	209	248	337	197	179	31	15	5	.38	1965+66
"	22		663	626	334	84	21	42	41	135	67	.05	"
"	24		292	327	383	556	447	202	99	42	26	.27	"
"	24	16	1191	32	53	32	37	51	10	4		.26	"
Weber, 1978	22	379	1450	273	87	40	17	1				.57	1965-67
"	22	548	989	232	27	17	20	4				.71	"
Friess, 1981	24			350	1015	976	452	179	79	19		.45	1968-70
"	24			448	1031	866	332	175	78	50	20	.30	"
"	24			483	1489	1570	860	352	197	41		.44	1968-72
"	24			576	1376	1392	722	426	304	129	75	.27	"
"	24			265	1332	1702	920	396	224	32		.45	1969-73
"	24			398	1245	1482	882	463	323	128	79	.22	"
Weber, 1978	22	1290	2169	488	148	36	10	3				1.01	1970-74
"	22	135	123	69	21	11	5	1				.63	"
Friess, 1981	24			274	1454	1752	865	337	198	25		.47	"
"	24			476	1323	1530	803	400	298	98	72	.23	"
"	24			314	1303	1721	988	352	199	31		.40	1971-75
"	24			474	1272	1558	918	360	267	92	59	.34	"
"	24			455	1380	1697	983	325	118	18		.45	1972-76
"	24			516	1449	1691	948	235	105	41	15	.46	"
"	24			476	1644	1671	796	268	105	18		.46	1973-77
"	24			560	1809	1568	757	175	91	36	4	.50	"
"	24			610	1788	1628	632	219	76	25		.44	1974-78
"	24			604	1764	1554	766	191	90	31		.47	"

Table 5 continued:

Author	Sub-	Age										(F+M)	Period		
	div.	0	1	2	3	4	5	6	7	8	9			10	
Friess,1981	24			764	2046	1362	589	197	72	24			.41	1975-79	
"	24			338	1104	859	449	145	80	25			.43	1976-78	
"	24			409	1481	825	247	66	25	7			.47	1977-79	
Hessle,1925	25				49	163	474	872	302	69	23		.34	1923+24	
"	27			55	637	497	1422	1840	906	269			.30	1921-24	
"	30+31				78	663	2248	2163	1213	226	176		.30	1923+24	
" 1927b	25-31			11	548	44	28	61	146	151	7	0	.29	1925	
" 1927b,1930	25			54	795	1007	115	21	10	28	10		.38	1926+27	
"	27			12	224	1096	220	133	67	124	124	20	.19	"	
"	30+31			27	472	772	267	72	37	217	114	5	.33	"	
Lundbeck,1930	26		3	57	19	2	2	2	1	1			.37	"	
"	26		1	96	69	3		1					.70	"	
"	26		8	314	119	19	21	5	5				.50	1926-28	
"	26			39	118	15	7	5	4	4			.26	1927	
"	26			52	96	39	6	1					.65	1928	
Hessle,1930	25			7	27	103	47	12	2				.52	1928+29	
"	27			1	14	71	69	20	13	9	4	1	.24	"	
"	30+31			2	20	56	65	34	11	4	1	3	.25	"	
Sjöblom,1961	29		211	357	236	159	41	6					.51	1935	
Meyer ² ,1942	26	98	1675	1563	703	650	281	92	2				.50	1935+36	
Blegvad,1943	25			14	13	22	15	13	11	8	3	1	.15	1938+39	
Alander,1943	25		1	111	216	63	17	9	9	7	3		.28	1939+40	
"	30+31			65	196	178	67	22	22	13	15	33	.18	"	
Meyer ² ,1942	26	362	5240	1894	140	116	41	20	7				.67	"	
Alander,1943	27			11	63	51	23	12	5	7	8	9	.06	1940	
"	25			17	117	156	254	27	11	1	1	1	.32	1941+42	
"	27			1	9	116	43	10	10	3	4	3	.23	1942	
"	30+31				6	31	100	88	32	15	10	12	.24	"	
Popiel,1955	26			198	131	55	3	1					.86	1946-48	
Alander,1949	25-27		7	37	42	19	36	24	17	11	2	1	.19	1947+48	
Popiel,1955	26			190	64	20	14	6	6				.35	1949-51	
Elwertowski,1954	25		238	167	182	144	145	101	100				-.14	1951	
Lishev,1960	28+29		1	16	22	19	19	12	7	3			.21	1950-59	
"	28			9	20	25	21	16					-.06	1953-59	
Hannerz,1956	30			3	19	26	19	6	5	6	8	4	.13	1954	
"	30		1	1	8	18	19	15	14	13	7	3	.12	"	
Sjöblom,1961	30-32		110	221	264	228	122	36	14	4	1		.38	1955-59	
Popiel,1968	25			1681	821	699	549	237	112	146	140	86	.06	1957-60	
"	25			206	315	463	671	767	441	271	283	249	169	-.04	"
"	26			381	294	352	493	699	395	302	320	270	246	-.11	"
Ojaveer,1974 ³	28	1000	273	74	20	6	2						.47	1958-62	
"	28	1000	432	186	80	35	15	6	3	1			.28	1958-64	
"	32	1000	677	458	310	210	142	96	65	44	30	20	.10	1959-65	
Strzyzewska,1969	26			37	489	118	91	17	19	4	4	4	.32	1961+63	

Table 5 continued:

Author	Sub-	Age										(F+M _w)		Period	
		div.	0	1	2	3	4	5	6	7	8	9	10		
Strzyzewska, 1969	26		311	2140	568	266	365	136	59	43	43	.21		1961-65	
Ojaveer, 1974	32 1000	756	571	432	326	247	186	141	106	86	61	-.006		1963-65	
"	28 1000	507	257	130	66	33	17	9	4	2	1	.33		"	
Sjöblom, 1966	32		57	184	466	269	11					.56		1964	
"	32		11	34	358	146	400	49	9			.46		"	
Ojaveer, 1974	28 1000	317	100	32	10	3	1					.54		1963-66	
"	28 1000	403	162	65	26	11	4	2	1			.43		1963-67	
"	28 1000	350	122	43	15	5	2	1				.48		1965+66	
Popiel, 1968	25		1671	970	393	260	232	200	155	90		.09		1965-68	
"	25		807	740	512	243	197	561	409	262	181	.17		"	
"	26		784	688	342	291	199	388	349	338	230	119	.06	"	
Ojaveer, 1974	32 1000	538	289	156	84	45	24	13	7	4	2	.24		1966-69	
"	32 1000	482	232	112	54	26	13	6	3	1	1	.34		"	
"	28 1000	454	206	93	42	19	9	4	2	1		.41		"	
Rechlin*, 1971	25 1000	208	43	9	2							.37		"	
Popiel, 1971-74	25		36	762	557	948	586	200	73	43	39	27	.25	1969-71	
"	25		159	758	769	777	186	145	81	39	38	32	.19	"	
"	26		271	705	442	434	280	213	159	140	89		.04	"	
" 1971-73	25		36	825	722	1028	786	240	186	82	40	26	.23	1969-72	
"	25		38	890	881	827	630	157	90	56	43	38	.21	"	
"	26		331	857	546	472	622	290	236	211	113	135	-.02	"	
" 1971-74	25		36	435	629	613	778	210	160	72	24	16	.27	1970-72	
"	25		306	326	780	697	579	141	64	40	23	23	.26	"	
"	26		291	465	442	350	525	555	191	172	88	82	.13	"	
"	25		71	444	394	618	634	515	171	91	34	10	.28	1971-73	
"	25		499	441	278	720	528	377	56	46	20	18	.28	"	
"	26		279	483	216	329	452	448	184	183	104	82	.09	"	
"	25		38	553	536	346	642	470	245	87	44	7	.30	1972-74	
"	25		462	487	277	248	606	395	370	68	32	37	.24	"	
"	26		95	300	247	208	526	458	455	196	124	120	.10	"	
Ojaveer, 1978	32		37	564	995	1108	655	124	187	132	5		.38	1973+74	
"	28		3	278	320	498	213	37	22	13	1		.44	"	
"	28		8	232	468	455	289	77	90	63	13		.25	"	
"	32		82	739	1489	1490	864	583	214	145	90		.22	1973-75	
"	28		39	392	594	552	241	102	28	13	3		.41	"	
"	28		44	289	727	658	276	191	136	87	62		.14	"	
Strzyzewska, 1975	25		59	685	670	424	189	496	167	147	65	35	.09	1973-75	
" 1975-77	25		416	480	375	301	217	460	400	225	50	38	.23	"	
"	26		86	221	233	283	318	529	440	347	121	127	.11	"	
" 1976-78	25		39	825	764	426	134	187	192	119	207	32	.06	1974-76	
"	25		435	508	382	342	222	187	443	215	185	40	.22	"	
"	26		111	312	242	381	382	315	480	303	197	90	.17	"	
Ojaveer, 1978	32		67	1025	1331	1025	968	631	364	155	97		.21	"	
"	28		49	688	537	280	244	102	44	17	4		.37	"	

Table 5 continued:

Author	Sub- div.	Age										(P+M _w)	Period	
		0	1	2	3	4	5	6	7	8	9			10
Ojaveer, 1978	28		37	344	616	500	464	245	182	109	67	.15	1974-76	
Sjöblom, 1975-79	29		10	175	771	941	930	740	429	302	262	159	.07	1973-77
"	30		44	316	1278	1196	786	513	360	212	138	82	.20	"
Sjöblom, 1975-79	31		148	615	658	847	763	851	566	311	128	63	.23	1973-77
"	32		32	840	1322	1049	699	451	329	113	82	46	.20	"
"	29	72	782	1387	1040	655	392	241	145	103	74	54	.13	"
"	30	50	636	1153	913	758	509	350	255	150	83	66	.17	"
"	31	8	512	1125	702	699	670	484	384	231	99	56	.21	"
"	32	45	653	1189	1040	852	532	337	190	67	59	23	.23	"
" 1975-77	29	38	592	782	612	539	483	405	215	209	110	62	.14	1974-77
"	30	27	966	729	621	464	295	224	160	172	113	96	.27	"
"	32	8	1187	847	536	366	405	163	131	63	42	14	.15	"
Ojaveer, 1978	32		50	791	790	704	404	567	332	36	94	.15	1975-76	
"	28		46	495	404	179	65	75	38	4	3	.38	"	
"	28		37	246	340	345	276	199	168	85	62	.10	"	
Strzyzewska, 1976	25		43	<u>826</u>	<u>666</u>	<u>402</u>	<u>195</u>	<u>155</u>	115	163	211	158	.23	1975-77
" 1976-78	25		<u>660</u>	<u>517</u>	<u>396</u>	<u>306</u>	<u>230</u>	<u>140</u>	142	229	194	106	.05	"
"	26		141	1073	461	472	403	345	<u>294</u>	<u>378</u>	<u>196</u>	<u>132</u>	.15	"
" 1977-79	25		38	<u>1149</u>	<u>600</u>	<u>323</u>	<u>174</u>	<u>133</u>	<u>101</u>	<u>77</u>	200	150	.15	1976-78
"	25		<u>788</u>	<u>655</u>	<u>369</u>	<u>248</u>	<u>222</u>	<u>152</u>	<u>138</u>	<u>66</u>	193	117	.07	"
"	26		278	2215	580	343	304	271	275	217	235	140-	.02	"
" 1978-80	25		26	1346	623	306	188	94	75	80	40	174	.16	1977-79
"	25		634	691	478	270	209	165	134	102	72	141	.05	"
"	26		350	2626	1020	369	265	242	263	267	163	200	.06	"
" 1979-81	25		19	1227	955	371	128	79	68	35	21	40	.25	1978-80
"	25		464	604	591	337	194	168	167	130	91	87-	.02	"
"	26		676	2257	1067	425	172	169	160	181	146	127	.06	"
Wrzesinski, 1984	25		3	893	850	666	199	74	54	38	34	47	.17	1979-81
"	25		504	552	490	401	207	152	162	130	103	74-	.03	"
"	26		780	1793	1223	565	241	178	164	155	121	110	.08	"

¹ Length compositions converted to age, see DR, Table 8² Length compositions converted to age, see DR, Table 8³ Numbers at age are not specifically stated by Ojaveer, 1974; n was read from his Figure 95, page 142 as e^{1nc} .⁴ Numbers at age are not specifically stated by Rechlin, 1971; n was calculated from his estimated $b = Z = 1.57$, giving numbers at age as e^{1nc} .

Underlined numbers indicate ages selected for mortality estimates if the whole range of fully recruited ages was not used.

Table 5 continued:

Author	Sub-	Age										(F+M _w)		Period
		div.	0	1	2	3	4	5	6	7	8	9	10	
Strzyzewska, 1969	26		311	2140	568	266	365	136	59	43	43	.21	1961-65	
Ojaveer, 1974	32	1000	756	571	432	326	247	186	141	106	86	61-.006	1963-65	
"	28	1000	507	257	130	66	33	17	9	4	2	1.33	"	
Sjöblom, 1966	32		57	184	466	269	11					.56	1964	
"	32		11	34	358	146	400	49	9			.46	"	
Ojaveer, 1974	28	1000	317	100	32	10	3	1				.54	1963-66	
"	28	1000	403	162	65	26	11	4	2	1		.43	1963-67	
"	28	1000	350	122	43	15	5	2	1			.48	1965+66	
Popiel, 1968	25		1671	970	393	260	232	200	155	90		.09	1965-68	
"	25		807	740	512	243	197	561	409	262	181	.17	"	
"	26		784	688	342	291	199	388	349	338	230	119	.06	"
Ojaveer, 1974	32	1000	538	289	156	84	45	24	13	7	4	2	.24	1966-69
"	32	1000	482	232	112	54	26	13	6	3	1	1	.34	"
"	28	1000	454	206	93	42	19	9	4	2	1		.41	"
Rechlin*, 1971	25	1000	208	43	9	2							.37	"
Popiel, 1971-74	25		36	762	557	948	586	200	73	43	39	27	.25	1969-71
"	25		159	758	769	777	186	145	81	39	38	32	.19	"
"	26		271	705	442	434	280	213	159	140	89		.04	"
" 1971-73	25		36	825	722	1028	786	240	186	82	40	26	.23	1969-72
"	25		38	890	881	827	630	157	90	56	43	38	.21	"
"	26		331	857	546	472	622	290	236	211	113	135-	.02	"
" 1971-74	25		36	435	629	613	778	210	160	72	24	16	.27	1970-72
"	25		306	326	780	697	579	141	64	40	23	23	.26	"
"	26		291	465	442	350	525	555	191	172	88	82	.13	"
"	25		71	444	394	618	634	515	171	91	34	10	.28	1971-73
"	25		499	441	278	720	528	377	56	46	20	18	.28	"
"	26		279	483	216	329	452	448	184	183	104	82	.09	"
"	25		38	553	536	346	642	470	245	87	44	7	.30	1972-74
"	25		462	487	277	248	606	395	370	68	32	37	.24	"
"	26		95	300	247	208	526	458	455	196	124	120	.10	"
Ojaveer, 1978	32		37	564	995	1108	655	124	187	132	5		.38	1973+74
"	28		3	278	320	498	213	37	22	13	1		.44	"
"	28		8	232	468	455	289	77	90	63	13		.25	"
"	32		82	739	1489	1490	864	583	214	145	90		.22	1973-75
"	28		39	392	594	552	241	102	28	13	3		.41	"
"	28		44	289	727	658	276	191	136	87	62		.14	"
Strzyzewska, 1975	25		59	685	670	424	189	496	167	147	65	35	.09	1973-75
" 1975-77	25		416	480	375	301	217	460	400	225	50	38	.23	"
"	26		86	221	233	283	318	529	440	347	121	127	.11	"
" 1976-78	25		39	825	764	426	134	187	192	119	207	32	.06	1974-76
"	25		435	508	382	342	222	187	443	215	185	40	.22	"
"	26		111	312	242	381	382	315	480	303	197	90	.17	"
Ojaveer, 1978	32		67	1025	1331	1025	968	631	364	155	97		.21	"
"	28		49	688	537	280	244	102	44	17	4		.37	"

Table 5 continued:

Author	Sub- div.	Age										(F+M _w)	Period	
		0	1	2	3	4	5	6	7	8	9			10
Ojaveer, 1978	28		37	344	616	500	464	245	182	109	67	.15	1974-76	
Sjöblom, 1975-79	29		10	175	771	941	930	740	429	302	262	159	.07	1973-77
"	30		44	316	1278	1196	786	513	360	212	138	82	.20	"
Sjöblom, 1975-79	31		148	615	658	847	763	851	566	311	128	63	.23	1973-77
"	32		32	840	1322	1049	699	451	329	113	82	46	.20	"
"	29	72	782	1387	1040	655	392	241	145	103	74	54	.13	"
"	30	50	636	1153	913	758	509	350	255	150	83	66	.17	"
"	31	8	512	1125	702	699	670	484	384	231	99	56	.21	"
"	32	45	653	1189	1040	852	532	337	190	67	59	23	.23	"
" 1975-77	29	38	592	782	612	539	483	405	215	209	110	62	.14	1974-77
"	30	27	966	729	621	464	295	224	160	172	113	96	.27	"
"	32	8	1187	847	536	366	405	163	131	63	42	14	.15	"
Ojaveer, 1978	32		50	791	790	704	404	567	332	36	94	.15	1975+76	
"	28		46	495	404	179	65	75	38	4	3	.38	"	
"	28		37	246	340	345	276	199	168	85	62	.10	"	
Strzyzewska, 1976	25		43	<u>826</u>	<u>666</u>	<u>402</u>	<u>195</u>	<u>155</u>	115	163	211	158	.23	1975-77
" 1976-78	25		<u>660</u>	<u>517</u>	<u>396</u>	<u>306</u>	<u>230</u>	<u>140</u>	142	229	194	106	.05	"
"	26		141	1073	461	472	403	345	<u>294</u>	<u>378</u>	<u>196</u>	<u>132</u>	.15	"
" 1977-79	25		38	<u>1149</u>	<u>600</u>	<u>323</u>	<u>174</u>	<u>133</u>	<u>101</u>	<u>77</u>	200	150	.15	1976-78
"	25		<u>788</u>	<u>655</u>	<u>369</u>	<u>248</u>	<u>222</u>	<u>152</u>	<u>138</u>	<u>66</u>	193	117	.07	"
"	26		278	2215	580	343	304	271	275	217	235	140	-.02	"
" 1978-80	25		26	1346	623	306	188	94	75	80	40	174	.16	1977-79
"	25		634	691	478	270	209	165	134	102	72	141	.05	"
"	26		350	2626	1020	369	265	242	263	267	163	200	.06	"
" 1979-81	25		19	1227	955	371	128	79	68	35	21	40	.25	1978-80
"	25		464	604	591	337	194	168	167	130	91	87	-.02	"
"	26		676	2257	1067	425	172	169	160	181	146	127	.06	"
Wrzesinski, 1984	25		3	893	850	666	199	74	54	38	34	47	.17	1979-81
"	25		504	552	490	401	207	152	162	130	103	74	-.03	"
"	26		780	1793	1223	565	241	178	164	155	121	110	.08	"

¹ Length compositions converted to age, see DR, Table 8

² Length compositions converted to age, see DR, Table 8

³ Numbers at age are not specifically stated by Ojaveer, 1974; n was read from his Figure 95, page 142 as e^{1nc} .

⁴ Numbers at age are not specifically stated by Rechlin, 1971; n was calculated from his estimated $b = Z = 1.57$, giving numbers at age as e^{1nc} .

Underlined numbers indicate ages selected for mortality estimates if the whole range of fully recruited ages was not used.

Table 6: Number at age for the estimation of $(F+M_w)$ in cod. Estimates are based on ages ≥ 1 . For natural mortality: DR, Table 1.

Author	Sub-div.	Age										$(F+M_w)$	Period
		0	1	2	3	4	5	6	7	8	9	10	
Strubberg, 1922	22	for Strubberg see Fig.4 and Table 11										.11	1906
"	22											.31	1907
"	22											.40	1907
Poulsen, 1931	22		4	52	175	99	15	4	5	1		.64	1909
Strubberg, 1922	22											.17	1912
"	22											.53	1912
Poulsen, 1931	22		15	115	99	114	162	48	18			.50	1913
"	22	138	75	37.2	27.4	1.3	.8					.89	1919-22
"	22	209	68	35.2	29.4	1.9	1.3	.1				1.01	1920-23
"	24	42	4.5	.4								2.13	1921-23
"	22	184	110	15	17	3.2	1.5	.1				.97	1921-24
"	22	177	105	46	18	3.9	1.7	.1				.78	1922-25
"	22	174	173	69	93	5	1.1	.2				1.37	1923-26
"	24	49	3.1	2.2	1.3	1.2	.2	.1				.66	1923+27+28
"	22	107	164	73	92	6.5	.8	.1				1.10	1924-27
"	22	122	128	69	78	4.8	2.1	.2	.4	.1		.92	1925-28
"	22	98	118	286	105	143	20	9.2	4.4	.1		.73	1926-29
"	24	19	4	49	52	61	9.2	2.1				.76	1927-29
Kändler, 1944	24		238	155	445	1025	912	697	107	309	23	.43	1925-38
"	22			17	317	204	203	172	56	73	31	.17	1929-38
"	22		195	190	39	9	5	5		5	3	.68	1931-38
"	24		62	4	19	46	45	38	9	16	3	.28	1931-38
"	22		72	47	55	35	33	23	9	7	2	.35	1933-38
"	24		18	12	36	15	22	14		11		.00	1938
"	24		116	60	39	104	34	27	5	13		.35	1938
Meyer, 1952	24		119	119	157	149	80	36	17	8		.44	1939-43
"	22		93	172	163	68	35	17	6	1		.64	1939-44
Thurrow, undated	22	225	718	435	150	42	11	2				1.05	1956-58
"	22	410	1548	903	228	65	18	14	2			.90	1956-60
"	22	380	2121	1457	204	50	10	14	2			.99	1957-61
"	22	666	2440	1452	161	42	8	12	2			1.01	1958-62
"	22	774	2993	1575	178	40	10	12	2			1.03	1959-63
"	22	589	3835	3925	296	89	11	12	4			1.03	1960-64
"	22	589	3475	4525	372	108	21	3	3			1.16	1961-65
"	22	400	3015	4219	520	233	40	7	5			1.08	1962-66
Tiews, 1971	24		621	211	54	46	43	21	4			.51	1962-66
Thurrow, undated	22	114	4195	4680	680	356	58	8	6			1.07	1963-67
"	22		3320	4824	899	412	72	12	8			1.04	1964-68
"	22		3820	2480	941	387	77	14	6			.99	1965-69
Bagge, 1989	22		273	3449	1453	470	46	9				1.20	1965-70
Thurrow, undated	22		3608	2665	843	391	69	12	7		3	.81	1966-70
Tiews, 1971	24		205	247	258	186	74	25	5			.62	1968-70
Thurrow, undated	22		3880	3026	962	272	56	8	5		3	1.06	1967-71
"	22		2335	7673	1783	318	62	8	5		3	1.20	1968-72
"	22		2322	8170	1826	320	59	6	3		3	1.28	1969-73
"	22		1206	8097	1799	318	60	5	3		3	1.26	1970-74
"	22		3020	8027	1759	306	58	5	2			1.32	1971-75

Table 6 continued:

Author	Sub-		Age										Period
	div.	0	1	2	3	4	5	6	7	8	9	10 (F+M ₁₀)	
Berner, 1974-86	24		319	1550	845	199	57	19	8	1	1	.88	1972-74
"	22		254	2969	1572	151	35	13	4	2		1.01	1972-76
"	24		387	2655	1467	342	91	37	14	5	1	.86	1972-76
Thurrow, undated	22		4070	9140	2704	323	74	7	4			1.27	1972-76
"	22		5453	4922	2091	311	55	7	3			.99	1973-77
Berner, 1974-86	22		207	3117	1393	201	37	16	5	3		.97	1973-77
"	24		208	2922	1332	404	81	30	14	6	1	.82	1973-77
Hessle, 1923	25-32			35	210	339	119	17	6	1		.81	1919-21
"	25-32			21	191	344	244	69	28	13	5	.56	1920-22
Poulsen, 1931	25	7	17	7.2	8.5	4.4	1.2	.4		.1		.60	1923+26+27
"	25	18	18	3.3	3.2	1.7	.2	.4		.1		.39	1925-28
Jensen, 1954, 59 ¹	>25	100	55	30	17	9	5	3	1			.39	1925-28
"	>25	100	49	24	13	7	4	2	1	1		.41	1925-28
"	>25	100	55	30	17	9	5	3	1			.39	1931-35
"	>25	100	49	24	16	10	7	4	3	2	1	.24	1931-35
Kändler, 1944	25		130	500	1120	1300	610	330	187	140	97	.29	1931-38
"	26			36	63	42	102	84	22	37	12	.27	1931-37
Jensen, 1954 ¹	25	1000	240	57	14	3						1.01	1936-39
" , 1959 ¹	25	1000	239	57	14	3						1.04	1936-39
Meyer, 1952	25		5	46	52	71	89	27	10	3	3	.51	1938-40
"	25			32	91	202	122	32	15	4		.65	1940-43
"	26		207	211	204	265	156	94	44	13	5	.49	1941-44
"	28			74	147	149	185	104	40	19	4	.51	1940-44
Chrzan, 1951	26			1418	2364	462	83	31	3			.93	1946+47
Dementjeva, 1959	25-29			123	767	1302	1053	447	194	87	27	.51	1946-49
Rutkowicz, 1959	26			180	420	300	60	18	1	1		.86	1948-51
Dementjeva, 1959	25-29		57	220	1253	1455	726	210	69	5	5	.71	1950-53
"	25-29			141	1026	1592	855	398	209	65	17	.58	1954-57
Jensen, 1954 ¹	25	1000	330	109	36	12	4	1				.80	1950-53
" , 1959 ¹	25	1000	210	44	9	2						1.05	1951-57
Chrzan, 1957	26		89	952	1763	1086	365	87	24	4	1	.82	1952-54
Rutkowicz, 1959	26			280	400	210	60	20	3	1		.81	1955+56
Stanek, 1965 ¹	25	1000	252	63	16	4	1					.79	1955-60
Kosior, 1975	25		141	1489	1606	961	593	160	27	5	8	.76	1960-64
"	26		50	1174	1864	1133	592	143	24	10	8	.75	1960-64
Tiews, 1971	25		327	239	199	157	60	14	4			.84	1962-66
"	25		106	143	353	271	102	21	4			.81	1962-66
"	28		53	304	309	217	370	35	9			.65	1962-66
"	26		46	152	328	330	109	23	12			.71	1964-66
Kosior, 1975	26		1	516	2599	1279	467	103	25	7	2	.87	1965-69
"	25		2	762	2601	1052	457	103	13	6	3	.85	1965-69
Tiews, 1971	25		76	78	278	326	184	50	6	1		.85	1968-70
"	25		76	132	144	262	73	10	2	1		.87	1968-70
"	28		4	63	266	401	185	52	16	8	4	.64	1968-70
"	26			118	425	342	90	17	8			.79	1968+69
Bagge, 1989	25		9	91	229	211	66	14				.82	1968-71
Kosior, 1975	26			68	1431	1096	862	182	42	19	6	.61	1970-73
"	25		2	172	1705	1293	654	138	21	9	4	.76	1970-73

¹ Total mortality was given by the author. The numbers in that case are not catch-, but number at age. This is

Table 7: Age-compositions of sprat converted from length-distributions acc.to a length-age key of Dixon (1932,1937).

Sprat,SD22,1935-37 Meyer,1942,p.599							Sprat,SD22,1937-41 Meyer,1942,p.599							Sprat,SD26,1935-36 Meyer,1942,p.602					Sprat,SD26,1939-41 Meyer,1942,p.603					
Lg.	Age						Age						Age					Age						
cm	2	3	4	5	6	7	2	3	4	5	6	7	2	3	4	5	2	3	4	5	6			
7	17						48						61					4						
8	96						277						381					74						
9	323	17					345	17					85	4				99	5					
10	376						260						177					46						
11	217		97	3				86	38	1					358	160	5	147		65	2			
12	34		453	42				47	618	58					41	545	51	54		716	67			
13	20		391	371				22	432	410					3	66	62	16		314	298			
14	101			106	23				161	170	38					63						66	15	
15	9			22	13				6	16	9													
16	2			4	4	4				1				1										
Tot.	436	664	1053	548	40	4	670	432	1255	655	48	1	527	583	771	118	177	268	1158	433	15			

Sprat,SD22,1940+41 Meyer,1942,p.600						Sprat,SD24,1939-41 Meyer,1942,p.601						Sprat,SD26,1935 Dixon,1937,p.8						Sprat,SD26,1931-32 Dixon,1932,p.391				
Lg.	Age					Age					Age						Age					
cm	2	3	4	5	6	2	3	4	5	6	2	3	4	5	6	2	3	4	5			
6											15											
7						40					73											
8						354					160											
9	1					112	5					109	5				132	6				
10	11					42						249					1830					
11	32		14			731	323	8					220	98	3	2526			1125	37		
12	3		39	4			114	1494	140					23	307	29	77			1013	95	
13	5			4	1	24		481	457					6	116	110	1			27	25	
14	1			2	1	63			66	15					18	18	4				1	
15							1			4	2											
Tot.	47	59	10	2		506	916	2362	675	17	357	503	539	160	4	132	4440	2165	158			

Table 8: Herring catches (Henking, 1920-22), converted from length-distributions according to Altnöder, 1928.

[illegible]

Table 9: Age composition of herring catches (Meyer, 1942) used to convert length to age in DR, Table 10

Lg. cm	Subdiv.22,1940+41								Subdiv.24,1940+41								Subdiv.26, 1940							
	Age								Age								Age							
	0	1	2	3	4	5	6	0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7	
9	4							1	3															
10	10	2						24	8	10														
11	17	3						83	1	32														
12	9	2						109	23	45														
13	3	4	1					60	32	90														
14		10	4						81	116	17													
15		12	118						384	396	30													
16		29	412	19					323	517	48	6					7							
17		11	321	56					28	252	57	7					23	19						
18		1	206	66					3	111	74	8	1					13	9	6				
19			83	80	15	1				31	77	38	1					19	21	30	5			
20			102	102	27	3				2	67	51	4					4	40	35	12			
21			7	134	50	21					40	63	10					3	18	22	43	21		
22				188	6	7	1				15	61	16	7				2	43	24	50	14		
23				165	5							28	28	7	2				25	24	26	29	9	
24				55	16	1						15	26	13	3				8	11	20	32	2	
25				14	5	1						2	10	2	1				6	2	5	27	18	
26				2									2	2	1							13	18	
27													1		3							4	5	
28															1								1	
29																								
30																							1	

Table 10: Age compositions of herring, converted from length distributions according to DR, Table 9

Lg. cm	Subdiv.22, 1935-37							Subdiv.22, 1938-41							Subdiv.24, 1935-37							
	Age							Age							Age							
	0	1	2	3	4	5	6	0	1	2	3	4	5	6	0	1	2	3	4	5	6	7
6								1														
7	49							6							1							
8	44							9							15							
9	91							14							87	29						
10	100	20						22	5						397	132	167					
11	191	34						88	15						954	13	358					
12	523	127						153	36						482	101	195					
13	387	509	122					87	115	27					199	109	296					
14		859	351					283	115						369	524	78					
15		59	602					48	482						303	316	26					
16		19	286	13				60	896	39					78	125	11	2				
17		14	401	78				41	1123	189					33	301	70	8				
18		5	349	111				9	653	210					8	441	299	32	8			
19			96	94	16	2			109	106	19	2				180	447	224	9			
20			86	88	24	2			14	14	4					15	398	302	22			
21			5	111	42	18					3	1						327	522	84		
22				39	1	1	1				2			1				140	578	149	65	
23				10	1														207	207	53	14
24				2							2								69	119	61	5
25											1		1						20	101	20	11
26																						
27																				17	17	9
28																				5		16
29																						4
30																					2	3
																					1	2
Σ	1115	1646	2298	546	84	23	1	380	612	3119	566	24	3	1	2135	1175	2818	1796	1964	722	219	64

Table 10 horizontally continued:

Lg.	Subdiv.24, 1938-41								Subdiv.26, 1935+36								Subdiv.26, 1939+40							
cm	Age								Age								Age							
	0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7
6																	3							
7	1								50								43							
8	49								40	10							216	54						
9	225	75							18	73							100	454						
10	178	59	75						204								860							
11	237	3	89						276								923							
12	405	85	164						278								1047							
13	332	181	493						286	15							797	42						
14		195	312	46					230	58							384	96						
15		570	594	48					160	161							463	463						
16		600	967	83	17				100	402							221	883						
17		114	1043	243	29				58	496	29						37	311	18					
18		12	671	455	48	12			245	171	117						68	47	33					
19			272	674	337	13			151	169	241	42					27	31	44	8				
20			25	680	516	38			27	233	201	69					3	30	26	9				
21				265	424	68			7	41	48	96	48				1	5	6	11	6			
22				111	459	119	52		1	42	24	50	15					5	3	6	2			
23					208	208	53	15		16	16	17	19	6				2	2	2	2	1		
24					70	122	62	5		2	3	6	9	1				2	2	4	6			
25					12	62	12	6					1	1	1						1	2	2	
26						15	15	8							1							1	2	
27						10	11	17														1	1	
28							8	8															1	
29							2	2																
30								1																
Σ	1427	1894	4705	2605	2120	667	215	62	98	1675	1563	703	650	281	92	9	362	5240	1894	140	116	41	20	7

Table 11: Results of tagging experiments on cod in the Belt Sea (SD 22) by Strubberg (1922).

Place	Year	Number tagged	Months after tagging	number recaptured
Little Belt	1912	200	12	82
			24	87
Bagenkop	1907	85	3	12
Great Belt	1907	110	11	25
North Samsø	1912	145	12	21
			24	24
Samsø	1906	47	5	3

Table 12: Tabulated values of F and C/N for M=0.2, from $C/N = (F/Z)(1-e^{-Z})$

F	.1	.2	.3	.4	.5	.6	.7	.8	.9	1.0	1.1	1.2	1.3	1.4
C/N	.086	.165	.236	.301	.360	.413	.462	.506	.546	.582	.616	.646	.673	.698

Table 13: Updated catch statistics 1938-62 of Baltic fish, in 1000 t, as compared to ICES Fisheries Statistics = F.St.: Bull.Stat (Anon.a,1906-1992). Catches of the countries shown are not contained in Fish.Stat (F.St.).

Year	Cod										Herring									
	SD 22				SD 24-32						SD 22				SD 24-32					
	F.St.	GDR	FRG	Tot.	F.St.	GDR	FRG	SU	PO	Tot.	F.St.	GDR	FRG	Tot.	F.St.	GDR	FRG	SU	PO	Tot.
1938	9.0			9.0	23.4			(3.8)		27.2	8.6			8.6	65.3					65.3
39	7.2			7.2	31.5			3.5		35.0	3.6			3.6	69.3					69.3
1940	8.4			8.4	46.6			12.9		59.5	4.4			4.4	42.8					42.8
41	10.3			10.3	75.3			(12.3)		87.6	4.6			4.6	57.8					57.8
42	13.9			13.9	65.9			(10.7)		76.6	4.0			4.0	68.8					68.8
43	17.2			17.2	74.9			6.1		81.0	4.3			4.3	77.6					77.6
44	17.7	2.8	20.5		60.8			(9.9)		70.7	5.2	3.7	8.9	63.0						63.0
45	15.1	5.0	20.1		14.4			(2.3)	1.5	18.2	3.2	5.3	8.5	62.8					.4	63.2
46	18.8	3.4	22.2		20.6			5.8	19.2	45.6	2.3	4.1	6.4	46.8					.6	47.4
47	13.6	1.3	5.0	19.9	22.9	5.3	13.8	10.9	29.4	82.3	1.9	.9	5.0	7.8	38.9	1.8	2.4	14.0	.5	57.6
48	20.0	1.9	7.7	29.6	31.6	2.2	21.0	17.8	32.6	105.2	3.2	1.3	6.8	11.3	41.8	4.2	2.5	20.3	.5	69.3
49	21.1	2.4		23.5	64.6	3.5		25.6	32.7	126.4	4.2	1.0		5.2	62.4	5.5		31.4	2.0	101.3
1950	18.8	2.0		20.8	40.0	8.8		41.9	48.0	138.7	3.9	1.0		4.9	66.6	10.0		47.3	3.3	127.2
51	24.0	2.1		26.1	35.6	14.0		46.9	51.2	147.7	13.7	1.1		14.8	56.7	11.5		55.5	7.2	130.9
52	26.9	1.9		28.8	41.4	21.4		49.0	61.2	173.0	13.1	.6		13.7	56.0	10.2		62.9	5.8	134.9
53	19.1	1.8		20.9	35.5	15.3		28.2	46.6	125.6	12.1	.6		12.7	86.8	12.2		64.2	13.0	176.2
54	19.6	1.5		21.1	33.8	11.3		40.6	48.7	134.4	11.7	.3		12.0	85.7	9.9		85.9	13.5	195.0
55	20.7	.7		21.4	114.3	12.2				126.5	18.0	.2		18.2	187.7	7.2				194.9
56	20.8	1.8		22.6	147.3	12.7				160.0	16.4	.6		17.0	183.7	6.8				190.5
57	21.8	2.2		24.0	173.8	22.2				196.0	18.3	.6		18.9	152.5	4.1				156.6
58	22.4	1.8		24.2	129.8	20.9				150.7	18.4	.5		18.9	164.5	6.1				170.6
59	18.4	2.7		21.1	124.5	16.5				141.0	16.8	1.3		18.1	168.5	3.5				172.0
1960	17.2	1.6		18.8	151.0	8.6				159.6	13.2	1.8		15.0	154.9	4.4				159.3
61	19.6	2.4		22.0	99.7	4.7	((25.3))			129.7	21.0	2.5		23.5	154.8	5.0				159.8
62	21.2	2.3		23.5	129.9	4.9				134.8	25.7	3.2		28.9	151.3	5.9				157.2

Abbreviations and explanations:

F.ST.: A publication on fishery statistics in the ICES convention area. This column gives the catches of all countries but those mentioned here and in DR, Table 16.

GDR: German Democratic Republic. Data from: Borrmann, H. & M. Berner, 1984. Gesamtfänge der See- und Küstenfischerei der DDR aus der Ostsee in den Jahren 1947-1962. Fisch.Forsch.22(3):11-22.

FRG: 1938-45: Germany; later on: Federal Republic of Germany. The data are extracted from files of the "Fischereianstalt des Landes Schleswig-Holstein, D-24 148 Kiel, Wischhofstr.1"

SU: UdSSR. Cod catches are as given by Dementjeva, T.F., 1959. Some data on the life history and fishery of cod in the central Baltic. Rapp.P.v.Reun., Cons.int.Explor.Mer, 147:68-73. The years 1939, 1940, 1943, 1946 are included there. Her catches divided by those of Fish.Stat. give fractions of 11%, 28%, 8%, 28%, averaging at 16.3%. This amount increases during the following years. The said fraction was used to value the catches for the missing years (in brackets). From 1955 onwards all catches of the USSR are shown in Bull.Stat.. However, the cod catches for 1961 are missing. These have been taken from Rpt:WG Assess.Dem.Stocks Baltic. C.M.1974/F:4, 20pp.(double brackets). The total cod catches and the catches of all species have been updated accordingly.

Table 13, right hand side, continued:

Year	Sprat							all species, cod, herring, sprat included									
	SD 22-32							SD 22					Sd 24-32				
	B.St.	GDR	FRG	SU	PO	Tot.		B.St.	GDR	FRG	Tot.	B.St.	GDR	FRG	SU	PO	Tot.
1938	11.7					11.7		26.6			26.6	150.0					150.0
39	2.2					2.2		18.5			18.5	135.7					135.7
1940	1.2					1.2		20.6			20.6	100.4					100.4
41	.8					.8		24.2			24.2	146.5					146.5
42	.7					.7		26.6			26.6	103.5					103.5
43	1.4					1.4		32.1			32.1	166.9					166.9
44	2.0		.1			2.1		35.2		7.2	42.4	139.9					139.9
45	1.0		.1			1.1		27.6		11.2	38.8	90.3				2.6	92.9
46	.9		.3		.1	1.3		31.6		8.2	39.8	80.9				22.2	103.1
47	1.1	.2	.4	2.1	.1	3.9		25.5	2.4	10.0	37.9	76.5	10.7	18.7	(31.9)	33.5	171.3
48	1.5	.5	2.7	2.8	.3	7.8		36.3	3.6	18.0	57.9	91.0	11.8	26.0	(48.3)	38.3	215.4
49	4.0	.9		4.0	1.1	10.0		37.8	3.6		41.4	146.2	14.8		(72.1)	43.7	276.8
1950	3.2	.5		5.6	1.1	10.4		36.8	3.2		40.0	124.9	24.3		(112.1)	58.1	319.4
51	3.4	.6		7.0	.7	11.7		55.8	3.6		59.4	107.8	32.9		(129.3)	64.2	334.2
52	3.3	.8		4.1	1.3	9.5		56.7	2.9		59.6	112.8	39.4		(137.1)	72.8	362.1
53	3.2	.8		4.3	2.2	10.5		46.4	2.6		49.0	143.4	36.5		(114.3)	66.7	360.9
54	4.1	.2		7.9	3.1	15.3		47.1	2.0		49.1	143.7	30.8		(158.9)	70.4	403.8
55	13.3	.1				13.4		60.4	1.5		61.9	370.6	28.4				399.0
56	8.5	.2				8.7		54.1	3.4		57.5	394.0	29.5				423.5
57	20.6	2.5				23.1		61.1	4.0		65.1	406.7	39.0				445.7
58	33.8	2.9				36.7		59.3	3.4		62.7	382.1	37.7				419.8
59	42.4	6.3				48.7		55.8	5.6		61.4	398.0	36.5				434.5
1960	34.2	8.6				42.8		49.2	4.9		54.1	405.7	33.3				439.0
61	40.8	8.8				49.6		68.2	7.8		76.0	364.0	26.5		((25.3))		415.8
62	63.0	17.9				80.9		68.6	8.3		76.9	397.8	36.9				434.7

Abbreviations and explanations continued:

SU continued:

The catches of herring and sprat are taken from FAO, Bulletin of Fishery Statistics 1937-38, 1947-61.

The total catches of the Soviet-Union in the Baltic Sea (including those for species other than sprat, herring, cod, additionally) are not stated in the above bulletin. ICES, Bull. Stat. shows, however, that USSR species other than herring, sprat, and cod made up for a fraction of .182 of the total catches of the UdSSR during the years 1955-60. This value was used to estimate the total catches of the UdSSR for the period 1947-54 and these are given in brackets.

PO: Poland. The catches are taken from: Laszczynski, S. et al., 1964. Statistics of Polish fisheries in the period 1920-1960. Prace Morsk. Inst. Ryb. 12B:299-334.

SD: Sub-division. Int. Balt. Sea Fish. Commiss. 1991. Fishery Rules. Rule 2 and App. I gives a breakdown of the convention area to subdivisions.

Table 14: Catches or landings of Baltic fish species, 1903-62, in 1000 t and the countries which reported these catches according to Anon.a,1906-1992 and to DR,Table 13 (but not DR,Table 16). Grd.Tot.includes all species.

Year	Sprat		Herring		Cod		Grd.Tot.		Coverage in Fish.Stat.											
	subdiv. 22-32	Subdiv. 22 24-32	Subdiv. 22 24-32	Subdiv. 22 24-32	22	24-32	SD22			SD 24-32										
							Sw	Dk	Gy	Sw	Dk	Fd	Gy	GD	Po	SU	La			
1903	.1	8.1 21.1	4.1 1.0	17.4 32.2	+	+			+	+	+	+								
04		8.0 12.1	3.5 .7	16.1 14.4	+	+			+	+										
05	.1	7.6 25.8	2.9 .1	15.4 30.6	+	+			+	+	+									
06	.2	8.5 28.6	2.3 .9	16.8 35.5	+	+			+	+	+									
07	6.5	9.2 44.7	2.2 2.4	15.7 87.1	+	+			+	+	+	+	+							
08	8.0	7.3 51.9	2.5 1.4	14.9 97.8	+	+			+	+	+	+	+							
09	1.1	8.2 42.7	3.0 2.8	18.2 58.1		+	+		+	+	+	+	+							
1910	1.6	6.6 39.9	4.1 2.4	18.9 73.9		+	+		+	+	+	+	+							
11	.9	8.4 39.9	4.4 1.6	21.3 71.8		+	+		+	+	+	+	+							
12	2.1	6.9 32.5	4.7 1.7	23.3 71.3		+	+		+	+	+	+	+							
13	2.6	12.0 41.6	3.4 1.9	28.5 77.2		+	+		+	+	+	+	+							
14	1.7	12.5 34.1	2.8 2.8	26.2 60.6		+	+		+	+	+	+	+							
15	2.1	16.7 32.8	3.7 4.3	28.3 64.2		+	+		+	+	+	+	+							
16	4.9	14.5 42.3	4.4 4.8	28.1 79.4		+	+		+	+	+	+	+							
17	2.4	7.5 49.2	4.3 2.2	19.0 80.6		+	+		+	+	+	+	+							
18	.3	8.1 47.9	6.1 2.1	24.5 73.8		+	+		+	+	+	+	+							
19	1.2	9.4 44.1	6.9 2.8	25.1 77.3		+	+		+	+	+	+	+							
1920	.7	12.2 41.7	7.0 4.5	26.6 78.2		+	+		+	+	+	+	+							
21	2.1	6.4 40.8	6.6 4.3	19.6 75.4		+	+		+	+	+	+	+				+			
22	2.8	5.5 40.0	5.7 4.8	17.5 81.2		+	+		+	+	+	+	+				+			
23	4.3	7.5 41.9	6.6 4.9	20.2 87.0		+	+		+	+	+	+	+				+			
24	3.3	12.3 42.0	6.1 5.3	24.2 94.5		+	+		+	+	+	+	+				+		+	
25	2.2	7.0 39.4	7.5 7.7	21.0 99.5		+	+		+	+	+	+	+				+		+	
26	1.8	6.3 40.4	9.9 7.4	24.0 91.5		+	+		+	+	+	+	+				+		+	
27	2.0	7.5 41.9	10.0 6.9	24.5 88.9		+	+		+	+	+	+	+				+		+	
28	3.5	13.1 44.6	11.7 7.2	31.9 93.5		+	+		+	+	+	+	+				+		+	
29	3.2	9.9 47.0	8.2 4.8	24.3 91.2		+	+		+	+	+	+	+				+		+	
1930	4.1	10.2 47.1	10.0 4.6	27.6 93.1		+	+		+	+	+	+	+				+		+	
31	8.0	7.4 42.1	9.8 4.1	25.2 91.0		+	+		+	+	+	+	+				+		+	
32	9.9	7.5 47.4	9.6 5.6	25.1 102.1		+	+		+	+	+	+	+				+		+	
33	10.7	6.3 51.1	9.9 6.8	23.3 104.5		+	+		+	+	+	+	+				+		+	
34	14.1	5.7 56.1	11.2 7.7	25.0 114.8		+	+		+	+	+	+	+				+		+	
35	19.3	6.6 60.5	11.3 11.2	26.3 129.1		+	+		+	+	+	+	+				+		+	
36	24.9	6.8 67.5	10.8 16.2	27.1 150.6		+	+		+	+	+	+	+				+		+	
37	6.4	6.8 64.6	10.1 20.9	26.4 133.5		+	+		+	+	+	+	+				+		+	
38	11.7	8.6 65.3	9.0 27.2	26.6 153.8		+	+		+	+	+	+	+				+	(+)	+	
39	2.2	3.6 69.3	7.2 35.0	18.5 139.2		+			+		+	+	+				+	(+)	+	
1940	1.2	4.4 42.8	8.4 59.5	20.6 113.3		+	+		+	+	+	+	+					(+)		
41	.8	4.6 57.8	10.3 87.6	24.2 158.8		+	+		+	+	+	+	+					(+)		
42	.7	4.0 68.8	13.9 76.6	26.6 160.3		+			+	+	+	+	+					(+)		
43	1.4	4.3 77.6	17.2 81.0	32.1 173.0		+	+		+	+	+	+	+					(+)		
44	2.1	8.9 63.0	20.5 70.7	42.4 156.3		+	+		+	+	+	+	+					(+)		

Table 14 continued:

Year	Sprat	Herring		Cod		Grd.Tot.		Coverage												
	Subdiv.	Subdiv.		Subdiv.		Subdiv.		SD22			SD 24-32									
	22-32	22	24-32	22	24-32	22	24-32	22	24-32	Sw	Dk	FR	Sw	Dk	Fd	FR	GD	Po	Su	La
1945	1.1	8.5	63.2	20.1	18.2	38.8	105.5			+	+		+	+	+	+			+	(+)
46	1.3	6.4	47.4	22.2	45.6	39.8	116.7			+	+		+	+	+	+			+	(+)
47	3.9	7.8	57.6	19.9	82.3	37.9	171.3			+	+		+	+	+	+	+	+	+	+
48	7.8	11.3	69.3	29.6	105.2	57.9	215.4			+	+	+	+	+	+	+	+	+	+	+
49	10.0	5.2	101.3	23.5	126.4	41.1	276.8			+	+	+	+	+	+	+	+	+	+	+
1950	10.4	4.9	127.2	20.8	138.7	40.0	319.4			+	+	+	+	+	+	+	+	+	+	+
51	11.7	14.8	130.9	26.1	147.7	59.4	334.2			+	+	+	+	+	+	+	+	+	+	+
52	9.5	13.7	134.9	28.8	173.0	59.6	362.1			+	+	+	+	+	+	+	+	+	+	+
53	10.5	12.7	176.2	20.9	125.6	49.0	360.9			+	+	+	+	+	+	+	+	+	+	+
54	15.3	12.0	195.0	21.1	134.4	49.1	403.8			+	+	+	+	+	+	+	+	+	+	+
55	13.4	18.2	194.9	21.4	126.5	61.9	399.0			+	+	+	+	+	+	+	+	+	+	+
56	8.7	17.0	190.5	22.6	160.0	57.5	423.5			+	+	+	+	+	+	+	+	+	+	+
57	23.1	18.9	156.6	24.0	196.0	65.1	445.7			+	+	+	+	+	+	+	+	+	+	+
58	36.7	18.9	170.6	24.2	150.7	62.7	419.8			+	+	+	+	+	+	+	+	+	+	+
59	48.7	18.1	172.0	21.1	141.0	61.4	434.5			+	+	+	+	+	+	+	+	+	+	+
1960	42.8	15.0	159.3	18.8	159.6	54.1	439.0			+	+	+	+	+	+	+	+	+	+	+
61	49.6	23.5	159.8	22.0	129.7	76.0	415.8			+	+	+	+	+	+	+	+	+	+	+
62	80.9	28.9	157.2	23.5	134.8	76.9	434.7			+	+	+	+	+	+	+	+	+	+	+

Abbreviations:

Subdiv.= SD: Sub-division. See bottom of DR, Table 13.

Grd.Tot.: Grand Total. The total catches of all species, sprat, herring, cod included.

(+): For the years marked with (+) catches of the Sovjetunion other than cod are not included.

Sw:	Sweden	GD:	German Democratic Republic
Dk:	Denmark	Po:	Poland
Fd:	Finland	SU:	UdSSR
FR:	Fed.Rep.of Germany	La:	Latvia
Gy:	Germany		

Table 15: Distribution of catches on sub-divisions, 1960-91. Comparison between data of Anon.a,1906-1992, other sources, and data of Assessment Working Groups.

Year	Sprat				Herring							
	SD: 22-32				SD: 22				22+24	24-32		25-32
	Fish.	GDR	Tot.	Ass.	Fish.	GDR	Tot.	Ass.	Fish.	GDR	Tot.	Ass.
	Stat.			WG	Stat.			WG	Stat.			WG
1960	34.2	8.6	42.8	42.8	13.2	1.8	15.0	31.5	154.9	4.4	159.3	146.1
61	40.8	8.8	49.6	49.9	21.0	2.5	23.5	38.1	154.8	5.0	159.8	149.3
62	63.0	17.9	80.9	80.9	25.7	3.2	28.9	45.1	151.3	5.9	157.2	155.7
63	61.1	8.0	69.1	67.9	22.9	3.3	26.2	40.0	192.0	7.6	199.6	193.0
64	80.8	14.7	95.5	96.2	38.1	1.5	39.6	55.1	177.9	6.1	184.0	171.0
65	73.6	11.2	84.8	83.1	29.5	2.3	31.8	47.1	185.4	9.1	194.5	181.5
66	69.6	21.2	90.8	91.6	31.7	3.6	35.3	59.4	201.0	15.0	216.0	195.8
67	61.5	11.0	72.5	71.6	35.1	8.6	43.7	69.3	232.1	34.3	266.4	245.1
68	74.1	9.6	83.7	90.8	28.7	7.4	36.1	56.5	286.9	29.4	316.3	299.8
69	111.4	7.3	118.7	124.7	25.8	3.8	29.6	48.9	250.3	15.4	265.7	255.9
1970	145.0	10.6	155.6	151.0	23.5	3.5	27.0	55.9	250.6	23.9	274.5	263.5
71	168.7	16.2	184.9	183.5	25.6	5.4	31.0	64.6	267.3	36.4	303.7	274.6
72	193.9	14.0	207.3	209.2	19.7	11.6	31.3	60.6	266.9	46.5	313.4	285.6
73	212.8		212.8	210.3	27.4		27.4	62.5	376.8		376.8	341.5
74	241.4		241.4	239.5	22.5		22.5	63.2	384.5		384.5	331.4
75	201.4		201.4	208.4	22.5		22.5	73.8	392.2		392.2	335.0
76	194.8		194.8	198.9	13.9		13.9	64.1	379.6		379.6	331.6
77	210.7		210.7	181.3	16.8		16.8	74.0	395.9		395.9	359.5
78	132.4		132.4	132.7	18.4		18.4	72.8	400.8		400.8	352.6
79	78.4		78.4	80.2	20.6		20.6	83.5	438.2		438.2	379.7
1980	57.7		57.7	58.2	26.1		26.1	100.3	439.1		439.1	359.8
81	47.3		47.3	49.2	25.7		25.7	90.2	405.8		405.8	343.9
82	47.8		47.8	49.1	26.9		26.9	107.5	426.3		426.3	360.6
83	30.9		30.9	37.3	23.7		23.7	108.1	449.9		449.9	376.7
84	54.0		54.0	52.9	28.0		28.0	101.8	409.2		409.2	332.2
85	71.2		71.2	69.5	26.4		26.4	101.9	415.3		415.3	336.9
86	77.9		77.9	75.8	21.6		21.6	92.1	389.2		389.2	318.6
87	91.3		91.3	88.2	18.9		18.9	101.3	354.1		354.1	301.1
88	85.7		85.7	80.3	17.7		17.7	98.9	389.6		389.6	323.0
89	79.4		79.4	85.8	.5		.5	92.9	380.6		380.6	326.2
1990	82.2		82.2	85.7	.5		.5	76.8	338.3		338.3	283.3
1				59.7				64.8				249.6

Explanations (continuation next page):

Data under the headings "GDR" and "Ass.WG" (Assessment Working Group) are from Council Meeting papers of ICES which are all listed in the reference list under "Anon.". Some assumptions had to be made, however. The Assessm.W.G. gives sprat data from 1963 onward only. Since these are nicely matched by the numbers given in Fish.Stat.(GDR included, see above) the latter numbers for 1960-62 have been put under "Ass.WG". For some countries, the herring catches 1960-62 are not given in working group reports. These are completed from "Fish.Stat." as well.

Table 15, right hand side continued:

Year	COD								Total: sprat, herring, cod included					
	SD: 22		22+24		24-32		25-32		SD: 22		24-32			
	Fish.	GDR	Tot.	Ass.	Fish.	GDR	Tot.	Ass.	Fish.	GDR	Tot.	Fish.	GDR	Tot.
	Stat			WG	Stat.			WG	Stat.			Stat.		
1960	17.2	1.6	18.8	32.0	151.0	8.6	159.6	141.0	49.2	4.9	54.1	405.7	33.3	439.0
61	19.6	2.4	22.0	36.0	99.7	4.7	129.7	110.0	68.2	7.8	76.0	364.0	26.5	390.5
62	21.2	2.3	23.5	35.0	129.9	4.9	134.8	114.0	68.6	8.3	76.9	397.8	36.9	434.7
63	19.2	2.3	21.5	31.2	127.7	5.4	133.1	128.7	59.0	8.0	67.0	425.5	32.2	457.7
64	23.0	1.5	24.5	35.8	105.1	3.6	108.7	102.7	82.2	8.4	90.6	417.3	33.6	450.9
65	23.1	1.6	24.7	44.9	105.2	3.7	108.9	102.5	69.3	8.4	77.7	421.2	33.7	454.9
66	23.0	2.4	25.4	42.5	135.7	3.5	139.2	134.9	79.0		79.0	516.9		516.9
67	23.2	2.3	25.5	44.1	144.6	5.4	150.0	152.4	77.2	17.2	94.4	498.1	68.6	566.7
68	26.7	4.4	31.1	51.9	157.3	10.2	167.5	164.5	72.6	16.7	89.3	586.0	66.7	652.7
69	24.8	5.3	30.1	42.3	154.2	12.5	166.7	169.9	67.4	11.7	79.1	582.2	46.6	628.8
1970	26.1	4.3	30.4	44.0	149.4	9.9	159.3	154.5	67.2		67.2	687.4		687.4
71	28.0	3.6	31.6	46.6	121.9	6.2	128.1	118.2	81.9		81.9	693.4		693.4
72	27.9	3.4	31.3	48.9	146.9	8.0	154.9	143.8	64.2	18.7	82.9	680.4	75.0	755.4
73	37.2		37.2	54.4	152.1		152.1	143.2	86.7		86.7	829.5		829.5
74	31.2		31.2	46.6	157.7		157.7	147.8	74.8		74.8	871.9		871.9
75	31.7		31.7	44.4	202.4		202.4	194.6	78.5		78.5	890.4		890.4
76	33.0		33.0	48.7	223.3		223.3	203.3	68.6		68.6	874.0		874.0
77	31.9		31.9	44.6	181.2		181.2	164.8	68.4		68.4	860.7		860.7
78	26.1		26.1	38.8	169.1		169.1	154.0	62.8		62.8	779.3		779.3
79	28.6		28.6	42.3	243.9		243.9	227.7	66.3		66.3	844.4		844.4
1980	25.9		25.9	38.2	366.1		366.1	347.6	68.4		68.4	926.9		926.9
81	29.2		29.2	51.3	353.4		353.4	330.7	75.5		75.5	862.1		862.1
82	24.5		24.5	45.7	341.0		341.0	316.1	70.9		70.9	873.0		873.0
83	26.3		26.3	47.2	353.8		353.8	332.1	66.6		66.6	884.3		884.3
84	31.4		31.4	47.6	414.9		414.9	391.0	72.6		72.6	926.4		926.4
85	24.1		24.1	38.2	323.6		323.6	315.1	62.9		62.9	858.3		858.3
86	13.1		13.1	25.7	260.1		260.1	252.6	51.3		51.3	771.6		771.6
87	14.0		14.0	26.9	223.7		223.7	207.1	56.4		56.4	708.8		708.8
88	11.2		11.2	27.9	214.1		214.1	194.5	59.1		59.1	731.1		731.1
89	.4		.4	17.7	110.3		110.3	179.2	1.3		1.3	617.5		617.5
1990	.3		.3	15.9	103.3		103.3	153.5	1.0		1.0	565.5		565.5
1								122.5						

Explanations continued:

Herring and cod catches of some countries are not split between sub-divisions 24 and, 25. This was done arbitrarily.

For abbreviations see annotations to DR, Tables 13, and 14.

Table 16: Updating of total catches (1000 tonnes) for years for which some countries did not report, based on their proportion of the total catch in other years¹ (Anon.a, 1906-1992). For abbreviations see Table 14.

Year	Total	Finland	Germany	Poland	Latvia	USSR ²	Catches to add					updat.
	T.14 ³	weight %	weight %	weight %	weight %	weight %/Cod	Fi	Gy	Po	La	SU	Total
1903	49.6		7.0 14.1						1	4		54.6
4	30.5						12	12	1	4		59.5
5	46.0							13	1	5		65.0
6	52.3	14.5 38.4						15	1	6		74.3
7	102.8								1	8		111.8
8	112.7		38.2 33.9						1	9		122.7
9	76.3	17.1 38.6	14.9 19.5						1	6		83.3
1910	92.8		33.3 35.9						1	8		101.8
1	93.1								1	8		102.1
2	94.6								1	8		103.6
3	105.7								2	9		116.7
4	86.8								2	7		95.8
5	92.5								2	8		102.5
6	107.5								2	9		118.5
7	99.6								2	8		109.6
8	98.3								2	8		108.3
9	102.4		30.5 29.8						2	8		112.4
1920	104.8		37.9 36.2						2	9		115.8
1	95.0			1.3 1.3						8		103.0
2	98.7			3.7 3.8						8		106.7
3	107.2									9		116.2
4	118.7			2.4 2.0	8.5 7.2							118.7
5	120.5			1.5 1.2	11.4 9.5							120.5
6	115.5											115.5
7	113.4											113.4
1928	125.4			2.3 1.8	10.0 8.0							125.4
1937	159.9											159.9
8	180.4									7		187.4
9	157.7									6		163.7
1940	133.9									23		156.9
1	183.0									22		203.0
2	186.9									19		205.9
3	205.1									11		216.1
4	198.7									18		216.7
5	144.3									4		148.3
6	156.5									10		166.5
7	209.2					31.9 1.9						209.2
8	273.3					48.3 1.7						273.3
9	317.9					72.1 1.8						317.9
1950	359.5					112.1 1.7						359.4
1	393.6					129.3 1.8						393.6

¹ The proportion of a country is estimated by use of appropriate total yields (DR, Table 14); i.e., the Finnish proportion in 1906 is 14.5/(52.3-14.5), in 1909 it is 17.1/(76.3-17.1-14.9).

² USSR catches of species other than cod are missing 1938-46. The years 1947-51 show an average multiplier of 1.8 to compute total yield from cod catches alone.

³ T.14=abbreviation for DR, T.14.

Table 17: Yield according to DR, Tables 14, and 15, but updated as per DR, Table 16, TotSHC = Total of sprat, herring, cod.

Year	Sprat	Herring	Cod	TotSHC	GrdTotal	Others	Year	Sprat	Herring	Cod	TotSHC	GrdTotal	Others
1903	0.1	32	6	38	55	17	1950	10	132	160	302	359	57
4	0.2	39	8	48	60	12	1	12	146	174	331	394	62
5	0.1	47	4	51	65	14	2	10	149	202	361	422	61
6	0.2	53	6	59	74	15	3	11	189	147	346	410	64
7	7	59	5	71	112	41	4	15	207	156	378	453	75
8	9	65	4	78	123	45	5	13	213	148	374	461	87
9	1	57	6	63	83	20	6	9	208	183	399	481	82
1910	2	51	7	60	102	42	7	23	176	220	419	511	92
1	1	53	7	60	102	42	8	37	190	175	401	483	81
2	2	43	7	53	104	51	9	49	190	162	401	496	95
3	3	59	6	68	117	49	1960	43	178	173	393	493	100
4	2	51	6	60	96	36	1	50	187	146	383	467	83
5	2	55	9	67	103	36	2	81	201	149	431	512	81
6	5	63	10	79	119	40	3	68	233	160	461	525	64
7	3	62	7	73	110	37	4	96	226	139	461	542	81
8	0.3	62	9	71	108	37	5	83	229	147	459	533	74
9	1	59	11	70	112	42	6	92	255	177	524	596	72
1920	1	60	13	73	116	43	7	72	314	197	583	661	79
1	2	51	12	65	103	38	8	91	356	216	664	742	79
2	3	49	11	64	107	43	9	125	305	212	642	708	66
3	5	54	13	70	116	46	1970	151	319	199	669	755	86
4	3	54	11	69	119	50	1	184	339	165	688	775	87
5	2	46	15	64	121	57	2	209	346	193	748	838	90
6	2	47	17	66	116	50	3	210	404	198	812	916	96
7	2	49	17	68	113	45	4	240	395	194	829	947	118
8	4	62	14	75	125	50	5	208	409	239	856	969	113
9	3	57	13	73	116	42	6	199	396	252	847	943	96
1930	4	57	15	76	121	45	7	181	434	209	824	929	105
1	8	50	14	71	116	45	8	133	425	193	751	842	91
2	10	55	15	80	127	47	9	88	463	270	813	911	98
3	11	57	17	85	128	43	1980	58	460	386	904	995	91
4	14	62	19	95	140	45	1	49	434	382	865	938	73
5	19	67	23	109	155	47	2	49	468	362	879	944	65
6	25	74	27	126	178	52	3	37	485	379	901	951	50
7	6	71	31	109	160	51	4	53	434	439	926	999	73
8	12	77	38	126	187	61	5	70	439	353	862	921	59
9	2	76	44	122	164	42	6	76	411	278	765	821	58
1940	1	55	80	136	157	21	7	88	402	234	725	772	47
1	1	69	98	168	203	35	8	80	422	222	725	790	65
2	1	80	100	181	206	25	9	86	419	197	702	758	56
3	1	86	104	191	216	25	1990	86	360	170	616	666	50
4	2	78	100	180	217	37	1	103	319	138	560	600	41
5	1	74	39	114	148	34	2	142	337	68	547	592	45
6	1	57	72	131	167	36							
7	4	65	102	172	209	38							
8	8	81	135	223	273	50							
9	10	107	150	266	318	52							

Table 18: Evaluation of biomass from fish consumption of seals, fishing yield, and Y/B₀, since 1970 based on ICES VPA-biomass, 1000 tonnes.

Year	Predation by seals	Yield to fishery	Yield to seals and fishery	Mor- tality	B= (C+Y) Y/B ₀	Mor- tality Y/B
	C	Y	C+Y	Y/B ₀	Y/B ₀	Y/B
1903	320	55	375	.180	2083	.026
4	320	60	380	.180	2111	.028
5	320	65	385	.180	2139	.030
6	320	74	394	.180	2189	.034
7	320	112	432	.180	2400	.047
8	320	123	443	.180	2461	.050
9	320	83	403	.181	2227	.037
1910	320	102	422	.182	2320	.044
1	298	102	400	.182	2198	.046
2	276	104	380	.184	2065	.050
3	253	117	370	.186	1989	.059
4	231	96	327	.189	1730	.056
5	224	103	327	.193	1694	.061
6	218	119	337	.195	1728	.069
7	211	110	321	.197	1629	.068
8	204	108	312	.200	1560	.069
9	197	112	309	.202	1530	.073
1920	191	116	307	.204	1505	.077
1	184	103	287	.206	1393	.074
2	177	107	284	.208	1365	.078
3	171	116	287	.210	1367	.085
4	164	119	283	.210	1348	.088
5	157	121	278	.208	1337	.091
6	150	116	266	.207	1285	.090
7	144	113	257	.205	1254	.090
8	137	125	262	.202	1297	.096
9	130	116	246	.200	1230	.094
1930	123	121	244	.197	1239	.098
1	117	116	233	.195	1195	.097
2	110	127	237	.192	1234	.103
3	103	128	231	.189	1216	.105
4	97	140	237	.187	1267	.111
5	90	155	245	.186	1317	.118
6	83	178	261	.186	1403	.127
7	76	160	236	.187	1262	.127
8	70	187	257	.192	1339	.140
9	63	164	227	.196	1158	.142
1940	62	157	219	.203	1079	.146
1	61	203	264	.218	1269	.160
2	60	206	266	.215	1237	.167
3	58	216	274	.219	1251	.173
4	57	217	274	.222	1234	.176
5	56	148	204	.223	915	.162
6	55	167	222	.221	1005	.166
7	54	209	263	.218	1206	.173
8	53	273	326	.206	1583	.173
9	52	318	370	.189	1958	.162

Table 18 continued:

Year	Predation by seals	Yield to fishery	Yield to seals and fishery	Mor- tality	B= (C+Y)	Mor- tality
	C	Y	C+Y	Y/B ₀	Y/B ₀	Y/B
1950	51	359	410	.174	2356	.152
1	49	394	443	.164	2701	.146
2	48	422	470	.156	3241	.130
3	47	410	457	.150	3047	.135
4	46	453	499	.149	3345	.135
5	45	461	506	.148	3419	.135
6	44	481	525	.152	3454	.139
7	43	511	554	.157	3529	.145
8	42	483	525	.161	3281	.147
9	40	496	536	.166	3229	.154
1960	39	493	532	.170	3129	.158
1	38	467	505	.174	2902	.161
2	37	512	549	.177	3101	.165
3	34	525	559	.178	3140	.167
4	32	542	574	.176	3261	.166
5	29	533	562	.161	3491	.153
6	26	596	622	.145	4290	.139
7	24	661	685	.130	5269	.126
8	21	742	763	.115	6635	.112
9	18	708	726	.100	7260	.098
1970	15	755	770	.096	8028	.094
1	14	776	790	.097	8161	.095
2	13	838	851	.110	7762	.108
3	12	916	928	.106	8726	.105
4	11	947	958	.142	6762	.140
5	10	969	979	.157	6251	.155
6	10	943	953	.115	8268	.114
7	10	929	939	.120	7808	.119
8		842			7586	
9		911			7171	
1980		995			6635	
1		938			6209	
2		944			6840	
3		951			7044	
4		999			7035	
5		921			6207	
6		823			5068	
7		772			5721	
8		790			5726	
9		758			6708	
1990		666			7979	
1		600			9082	

Abbreviations: B₀ Underestimated biomass of all fish species based on Table 9 of the main report.
 C consumption of seals as per Elmgren(1989), and Figure 4 of the main report.
 Y Yield of the fishery (1000 tonnes) as per DR, Table 17.
 Y/B₀ interpolated from Table 9 by means of Figure 11, both from the main report.
 B Until 1969 estimated biomass, since 1970 biomass based on VPA of all fish species.

Table 19: Catch of cod in SD 22 per 10 hrs trawling (Steffensen & Bagge,1990), VPA-biomass (Anon.d,1992) and the predicted biomass calculated by a regression between these variables.

Year	kg/10 hrs	VPA	Biomass	predicted biomass
1963	12.9			145
64	10.8			122
65	9.0			103
66	12.3			139
67	8.2			94
68	7.7			89
69	8.0			92
1970	8.2		89.5	94
71	7.3		97.7	85
72	11.0		96.7	125
73	7.1		96.0	82
74	6.4		89.1	75
75	7.2		85.2	84
76	7.8		87.6	90
77	7.1		69.4	82
78	7.5		74.2	87
79	9.3		78.4	106
1980	5.7		77.1	67
81	6.6		83.3	77
82	6.0		75.9	70
83	4.6		78.0	55
84	4.9		71.3	59
85	6.8		63.4	79
86	2.3		41.2	31
87	5.0		47.5	60
88	2.4		43.8	32

Tab.20: Various VPA-estimates of cod biomass (1000 tonnes) in subdivisions 25-32

Year	Anon.d,1992 VPA	Anon.d,1987, VPA	Kosior,1975	Berner&Borr- mann,1980	Anon.d,1992 completed ¹	Berner&Borr- mann, completed ²	Anon.d,1992 completed ³
1960			185.4			317	283
1			174.0			297	265
2			179.5			306	273
3			180.8			309	276
4			175.7			303	271
5			177.6	316		316	282
6		415	201.2	400	333	400	333
7		496	230.1	437	398	437	398
8		486	242.4	452	390	452	390
9		459	269.2	448	368	448	368
1970	343	420	274.8	418	343	418	343
1	313	395	258.5	404	313	404	313
2	347	443	287.6	436	347	436	347
3	385	500	238.8	448	385	448	385
4	480	598		507	480	507	480
5	551	674		546	551	546	551
6	517	651		496	517	496	517
7	508	684			508		508
8	675	879			675		675
9	926	1146			926		926
1980	991	1219			991		991
1	949	1212			949		949
2	996	1208			996		996
3	968	1174			968		968
4	888	1113			888		888
5	712	883			712		712
6	531	669			531		531
7	475				475		475
8	455				455		455
9	359				359		359
1990	287				287		287
1	210				210		210

¹ completed for the years 1966-69 by regression to "Anon.d,1987".² completed for the years 1960-64 by regression to "Kosior,1975".³ "Anon.d,1992,completed¹" is further completed for the years 1960-65 by regression to "Berner&Borrmann, completed²".

Tab.21: Stock size of sprat in the Baltic for the years 1970-73 as estimated by VPA. The numbers in the catch were taken from Anon.d,1982. M equals the variable natural mortality for 1974 as stated there. Weight at age is as for 1974 from the same report, except that the values were smoothed.

Age	M_{1974}	w_{1974},g smoothed	Total Biomass, SD 22-32, 1000 Tonnes			
			1970	1971	1972	1973
0	.60	4.0	373	489	1108	543
1	.50	7.9	868	404	530	1200
2	.42	10.3	494	677	314	406
3	.38	11.9	1163	366	489	227
4	.43	13.1	244	785	251	340
5	.43	13.9	45	153	460	144
6	.40	14.4	32	23	85	235
7	.42	14.7	4	14	11	51
8+	.42	14.9	1	1	4	6
2-8+			1984	2019	1613	1410
1-8+			2852	2423	2143	2609
0-8+			3225	2912	3251	3152

Tab.22: Stock size of Baltic herring in subdivisions 25-29,32 + Gulf of Riga, as estimated by VPA. Numbers in the catch are from Anon.b,1977,1979, M for 1974 and w for 1974 (smoothed) as given in Anon.b,1992.

Age	M_{1974}	w_{1974},g smoothed	Total Biomass, SD 25-29,32, G.Riga, 1000 Tonnes			
			1970	1971	1972	1973
0	.33	7	475	264	395	333
1	.54	25	814	1212	677	1013
2	.27	38	523	675	1012	529
3	.26	48	1224	453	567	864
4	.24	57	250	955	383	470
5	.24	64	198	184	723	314
6	.22	70	210	147	140	534
7	.22	75	27	161	112	104
8	.21	80	22	15	126	83
9	.19	83	14	12	8	94
10+	.19	86	3	7	8	2
Tot.						
2-10+			2470	2609	3080	3045
1-10+			3283	3821	3758	4059
0-10+			3759	4086	4153	4391

Table 23: Estimate of total biomass of herring in the Baltic for ages > 1, (1000 t), based on DR, Table 22, Anon.b (1991), and Anon.b(1992).

Year	SD25-29,32,Riga B.	SD 30+31	SD 25-32	SD 22+24	Baltic total
1970	3 283 ¹	222 ²	3 505	312	3 817
71	3 821	258	4 079	326	4 405
72	3 758	254	4 012	314	4 326
73	4 059	274	4 333	288	4 621
74	3 070	218	3 288	252	3 540
75	3 072	221	3 293	221	3 514
76	3 614	262	3 876	179	4 055
77	3 673	258	3 931	191	4 122
78	4 009	245	4 254	225	4 479
79	3 805	256	4 061	266	4 327
1980	3 705	211	3 916	325	4 241
81	3 372	203	3 575	345	3 920
82	3 894	189	4 083	362	4 445
83	3 048	216	3 264	389	3 653
84	3 348	268	3 616	385	4 001
85	3 217	263	3 480	322	3 802
86	2 838 ³	242	3 080	238	3 318
87	3 108	254	3 362	277	3 639
88	3 437	260	3 697	279	3 976
89	3 628	314	3 942	263	4 205
1990	4 292	360	4 652	212	4 864
91	4 468	356	4 824	200 ⁴	5 024

¹ 1970-73 from DR, Table 22.

² 1970-73 estimated from a regression of VPA-B in SDs 30+31 vs VPA-B in SDs 25-29+32+ Gulf of Riga (DR, Figure 8).

³ A comparatively low biomass for 1986 of 2.335 million tonnes is stated in Anon.b, 1992. If this years value is re-evaluated with stock numbers and weights given in C.M.1992/Assess:13, Tables 3.3.3, and 3.3.7, a biomass of 2 838 075 tonnes results. This value is used here.

⁴ C.M.1992/Assess:13 gives no separate assessment for 1991 in SD 22+24. This value was therefore estimated from a regression of VPA-B in SDs 22+24 vs VPA-B in SDs 22+24+ Kattegat (DR, Figure 9).

Table 24: Data for the calibration of $Y/(F+M_M)$ of cod in sub-division 22+24 versus VPA-biomass.

Period	$F+M_M$ (DR, Table 6)	Yield(Y) (DR, Tables 14, 15)	$Y/(F+M_M)$	Biom.DR.Tab.19 1963-69 predicted ≥ 1970 : VPA
1963 - 67	1.07	39.7	37.1	120
1964 - 68	1.04	43.8	42.6	109
1965 - 69	.99	45.1	45.6	103
1965 - 70	1.20	45.0	37.5	101
1966 - 70	.81	45.0	55.6	101
1968 - 70	.62	46.1	74.4	90
1967 - 71	1.06	45.8	43.2	92
1968 - 72	1.20	46.7	38.9	93
1969 - 73	1.28	47.2	36.9	94
1970 - 74	1.26	48.1	38.2	94
1971 - 75	1.32	48.2	36.5	93
1972 - 74	.99	50.0	50.5	94
1972 - 76	1.05	48.6	46.3	91
1973 - 77	.93	47.7	51.3	86

Table 25: Basic data for the construction of artificial stock and catch in order to analyse the reliability of the Catch Curve Method. The stock has been in a steady state until year 1. $F = Z - M$. M at age zero = Z .

Year	Recruits at age 0	Z	Year	Recruits at age 0	Z
1	13 360	1.1	19	18 033	1.0
2	7 332	1.1	20	2 697	.9
3	8 955	1.1	21	3 294	1.1
4	10 938	1.0	22	8 955	1.0
5	6 003	1.0	23	6 003	1.2
6	6 634	.9	24	12 088	1.2
7	1 636	.8	25	2 697	1.3
8	3 641	.8	26	16 318	1.4
9	8 955	.7	27	13 360	1.5
10	2 981	.6	28	18 034	1.6
11	5 432	.6	29	5 234	1.7
12	2 697	.7	30	19 930	1.7
13	2 981	.6	31	17 765	1.6
14	1 998	.8	32	9 897	1.5
15	1 808	.6	33	3 294	1.2
16	3 294	.8	34	6 003	1.0
17	3 641	.9	35	2 208	.8
18	5 432	.9	36	2 697	.8

Age,	0	1	2	3	4	5	6	7	8	9
N , year 1,	13 360	4 447	1 480	493	164	55	18	6	2	1
M ,	Z	.56	.36	.32	.29	.27	.25	.24	.23	.23

N at age 0 of year 1 is from the above table.

N at age 1 in year 1 = $13\,360 * e^{-1.1} = 4\,447$ a.s.f.

Table 26: Coefficients of Fishing Mortality of a simulated fish stock. $F_{0.1-100}$ from artificially constructed samples, $F_{0.1-100}$ estimated from these samples by the present method. Means of mortalities (\geq age 1) are weighted by biomass averaged over the year. Mean weight at age averaged over the year = w . Number of recruits at age zero = R .

Years	Set	R	$Z_{0.1-100}$	$Z_{0.1-100}$	$F_{0.1-100}$	$F_{0.1-100}$
1 - 3	1	29 697	1.10	.99	.63	.53
4 - 6	2	23 575	.97	.93	.51	.47
7 - 9	3	14 232	.77	.88	.36	.41
10 - 12	4	11 110	.64	.71	.20	.30
13 - 15	5	6 787	.66	.64	.28	.26
16 - 18	6	12 367	.87	.55	.45	.30
19 - 21	7	24 024	.98	.99	.49	.53
22 - 24	8	27 043	1.14	.99	.68	.53
25 - 27	9	32 395	1.40	1.32	.87	.83
28 - 30	10	42 198	1.66	1.54	1.16	1.04
31 - 33	11	30 906	1.43	1.59	.93	1.08
34 - 36	12	10 108	.86	1.13	.46	.55

Age, [y]	0	1	2	3	4	5	6	7	8	9	10
$N [y^{-1}]$	.90	.56	.36	.32	.29	.27	.25	.24	.23	.23	.23
$w, [g]$	11	25	33	39	44	47	49	50	50	50	50

Table 27: Herring, catch per effort, data read from the graph of Jensen (1927, J.Cons.2(1):44-49)

Year	Catch, t	no. motorvessels	Catch/vessel/year, t
1901	1140	0	0
2	1360	20	69
3	1270	4	318
4	780	10	78
5	1420	8	178
6	1690	23	73
7	1880	32	59
8	1890	48	39
9	2740	74	37
1910	1710	92	19
11	1660	120	14
12	2960	127	23
13	2900	132	22
14	2370	132	18
15	1780	138	13
16	3570	149	24
17	3140	153	21
18	3790	150	25
19	3110	168	18
1920	1720	173	10
21	3400	180	19
22	2350	194	12
23	2580	217	12
24	2450	238	10

Table 28: Numbers and original sizes of prey eaten by mammals¹.
 Torm&Rez=Tormosov&Rezov, 1978; Härk=Härkönen, 1980, 1986; Thomp=Thompson et al 1991; Siev=Sievers, 1989;
 Behr=Behrends, 1981; Lindroth=Lindroth, 1962. G.s.=R.s., H.s.=Grey, Ringed, Harbour seal.

Author		Söderberg, 1975					Torm&Rez		Härk	Thomp	Siev	Behr	Lick, 1991	Lindroth					
Mammal		G.s.		R.s.		H.s.		G.s.		R.s.		Harbour seal				Porpoise			
Size of mammal, kg		148	59									48				70			
Number of mammals analysed		144	52	7	58	43		?		40	103	130	102		50				
n=numb; cm=av. length; g=av. weight		n	n	n	n	n	n	cm	g	cm	g	g	g	cm	g	cm	g	cm	g
Herring	Clupea harengus	312	127			138	241	23.7	93	12.9	16			17.5	42	17	39		
Sprat	Clupea sprattus	112				45	45	11.3	10	11.6	12			12.5	14				
Cod	Gadus morhua	98	13	4	17			20	70	12.2	36	71	67	28.1	200 ⁴	22	138		
Salmon	Salmo salar	32	11																
Sea Trout	Salmo trutta	13	8																
Whitefish	Coregonus lavaretus	49	53	4															
Vendace	Coregonus albula	7	21																
Smelt	Osmerus eperlanus	67	10			70						34	18	15	21				
Eel	Anguilla anguilla	25	5	10															
Plaice	Pleuronectes platessa							22.7	140				30						
Flounder	Pleuronectes flesus	15		4	6					24.8	145	65	58	10.6	14				
Turbot	Psetta maxima	22		2															
Dab	Limanda limanda	21						22	103			14	58	12.5	28				
Sandeel	Ammodytes spec.	27	36					13.6	8	9.3	3	11		17.5	18				
Eelpout	Zoarces viviparus	7	7			9	7							15	18				
Fatherlasher	Myoxocephalus scorpius	3	12									45		2.5	0.2				
Longspined	Taurulus bubalis	4																	
fatherlasher																			
Fourhorned	Myoxoceph. quadricornus	6	23			7						45							
sculpin																			
Goby	Coryphopterus flavescens	19								5.2	1	2	2.8	2.5	0.2				
Pike	Esox lucius	6																	
Perch	Perca fluviatilis	16			7														
Ruffe	Acerina cernua	5	6																
Lamprey	Lampræta fluviat.					19 ²	5 ²												
Stickleback	Gasterosteus aculeatum						20 ³												
Roach	Rutilus rutilus						2 ³												
White Bream	Blicca sp.						1 ³												

¹ Numbers stated for Tormosov&Rezov are based on the mean numbers given by Söderberg, 1975. see Text

² Lamprey not found by Söderberg. The value for eel was used because of the similar shape.

³ Stickleback, roach, bream not mentioned by Söderberg, 1975. A single fish per seal with that item was assumed

⁴ The original data of Lick result in 28.1 cm, much higher than from the other sources. Among his numbers, there is an outlier with 4 cod of 50-55 cm (2 kg). It is assumed that these fish stem from fishing gears. They are omitted.

Table 29: Weight-length relationships, $W=a \cdot L^b$, according to Hårkönen(1986) and Lick(1991)					
Species	Hårkönen		Lick		
	a	b	a	b	
herring	0.0015	3.48	0.005	3.16	
sprat	0.0012	3.73	0.0035	3.28	
cod	0.0108	2.93	0.0079	3.15	
salmon	0.2439	2.22			
sea trout	0.0153	2.82			
whitefish	0.0007	3.07			
vendace					
smelt	0.0019	3.42	0.005	3.09	
eel	0.0049	2.72	0.0008	3.24	
plaice	0.003	3.36	0.0631	2.41	
flounder	0.0688	2.44	0.0151	2.88	
turbot	0.0146	3.09	0.0363	2.77	
dab	0.0048	3.24	0.02	2.87	
sandeel	0.0006	3.61			
eelpout	0.0002	3.97	0.004	3.1	
fatherlasher	0.0068	3.27	0.011	3.11	
longspined fatherlasher	0.0105	3.12			
fourhorned sculpin	0.008	3.13			
goby	0.0067	2.89	0.0185	2.52	
pike	0.0006	3.55			
perch	0.007	3.17			
ruffe	0.0006	4.37	0.0168	2.94	
lamprey					
stickleback			0.005	3.52	
roach					
white bream					

Table 30: Number of prey per 100 mammals and mean prey weights, porpoise adapted to harbour seal and the average of the latter adjusted to Grey, and Ringed seal according to the fish intake (Gs=Grey s.3.2kg; Rs=Ringed s.1.7kg; Harbour s.2.1kg; porpoise 1.8kg, from Elmgren, 1989). Söd=Söderberg, 1975; Tor&Rez=Tormosov&Rezov, 1978; Härk=Härkönen, 1986; Thom=Thompson et al. 1991; Lick=Lick, 1991; Lind=Lindroth, 1962; Siev=Sievers, 1989; Behr=Behrends, 1981;

Prey species	No. of prey corresponding to 100 predators												Average weights		
	porpoise adapted to												Harbour seal: 2.1/1.8 = 1.1667		
	Gs	Rs	Gs	Rs	Härk	Thom	Lick	Lind	Siev	Behr	Mean	3.2/2.1	Gs	Rs	1.7/2.1
Herring	217	244	238	560	93	16	49	46			51	78	41		
Sprat	78		78	105	10	12	16				13	20	11		
Cod	68	25	29		70	36	233	161	71	67	106	161	86		
Salmonids	70	179									79 ¹	120	64		
Smelt	47	19		163			25		34	18	26	40	21		
Eel	17	10									27 ²	41	22		
Plaice					140	145				30					
Flounder	10		10				16		65	58					
Turbot	15										66	101	53		
Dab	15				103		33		14	58					
Sandeel	19	69			8	3	21		11		11	17	9		
Eelpout	5	13	16	16			21				21	32	17		
Cottids	9	67		16			0.2		45		30	46	24		
Gobies	13					1	0.2		2	2.8	2	3	2		
Pike	4										80 ³	122	65		
Perch	11		12								70 ⁴	107	57		
Ruffe	3	12									15 ⁵	23	12		
Lamprey			33	12							27 ²	41	22		
Stickleb.				47							1 ⁶	2	1		
Cypnid.				7							50 ⁷	76	40		
Total															

1 assumed. Mean no per seal: salmon 2, sea trout 3, whitefish 9, vendace 9. Mean size together 20cm, corresponding to a brook trout of 79g (Lick, 1991).

2 assumed. For eel and lamprey a mean size of 25cm was assumed, weight from Lick (1991).

3 assumed. Mean size of 20 cm and $W = 0.01 \cdot L^3$ assumed.

4 assumed. Mean size assumed to be 17cm, weight from Lick (1991) acc. length/weight relationship for ruffe which reproduces lengths and weights given by Muus/Dahlistrom (1968) for perch.

5 assumed. Mean size given by Muus/Dahlistrom (1968) 12-15cm, prey size assumed here 10cm, weight from Lick (1991).

6 assumed. Weight for a length of 5cm from Lick (1991).

7 50g assumed.

Table 31: Weight of prey consumed by 100 predators and (cons.rates=)consumption rates (weight of prey consumed as fraction of total weight of all fish prey consumed).

Prey species	Tot.weight of prey p.100 mamm.				Consumption rates				comb. groups,		Cons.
	corrected for different prey size								.9 Söderberg +		rate
	Söderberg		Tormos&Rezov		Söderberg		Tormos&Rezov		.1Tormos&Rezov. ¹		.7Ring+
	Grey s.	Ring.s.	Grey s.	Ring.s.	Grey s.	Ring s.	Grey s.	Ring s.	Grey s.	Ring s.	.3Grey ²
Herring	16926	10004	18564	22960	0.36	0.37	0.64	0.8	0.39	0.41	0.4
Sprat	1560		1560	1155	0.03		0.05	0.04	0.03	0.01	0.02
Cod	11016	2150	4698		0.23	0.08	0.16		0.22	0.07	0.11
Salmonids	8400	11456									
Smelt	1880	399		3423							
Eel	697	220									
Plaice											
Flounder											
Turbot	4040		1010		0.38	0.55	0.15	0.16	0.36	0.51	0.47
Dab											
Sandeel	323	621									
Eelpout	160	221	512	272							
Cottids	414	1608		384							
Gobies	39										
Pike	488										
Perch	1177		1284								
Ruffe	69	144									
Lamprey			1353	264							
Stickleb.				47							
Cyprinid.				280							
Total	47189	26823	28981	28785					1	1	1
Grey/Ring	1.76		1.01								

¹ For the use of the fractions 0.9 and 0.1 see text.

² Fractions 0.7 and 0.3 according to Elmgren (1989).

Table 32: Estimation of sprat biomass for periods

Period	Y ₁	Y ₂	C _{tot} = consumpt.	Bu ₁	Bu ₂ =	ΔC_s	ΔC_s	C _s =	B =	F =
	Thurrow, 1997	DR, Table 17	of seals	Thurrow, 1997	Y ₂ /			$\Delta C_s \cdot C_{tot}$	(Y ₂ + C _s)/	Y ₂ /B
	Table 2		DR, Table 18	Table 2	(Y ₁ /Bu ₁)				(Y ₂ /Bu ₂)	
1903-09		2.51	320	23.6 ³⁾	24	0.0045	0.0035	1.12	34	0.073
1910-19		2.13	243	20.0 ³⁾	20	0.0031	0.0020	0.49	24	0.087
1920-29	3.33	2.7	161	14	11	0.0025	0.0012	0.19	12	0.230
1930-39	12.89	11.1	93	40	34	0.0057	0.0029	0.27	35	0.319
1940-49	1.30	3.0	57	5	12	0.0015	0.0010	0.06	12	0.245
1950-59	18.27	18.9	46	109	113	0.005	0.0037	0.17	114	0.166
1960-64	86.70	67.6	36	742	578	0.0262	0.0209	0.75	584	0.116
1965-69	95.65	92.6	24	1029	996	0.0317	0.0311	0.75	1004	0.092
1968-72	178.81 ¹⁾	152.0	16	1238 ¹⁾	1056	0.02	0.0200	0.32	1058	0.144
1973-77	227.44 ²⁾	207.6	11	2471 ²⁾	2257	0.0354	0.0366	0.40	2261	0.092
	¹⁾ 1969-73			³⁾ correl. Bu ₁						
	²⁾ 1973-75			v Y ₂						

Table 33: Estimation of herring biomass for periods

Period	Y ₁	Y ₂	C _{tot} = consumpt.	Bu ₁	Bu ₂ =	ΔC_s	ΔC_s	C _s =	B =	F =
	Thurrow, 1997	DR, Table 17	of seals	Thurrow, 1997	Y ₂ /			$\Delta C_s \cdot C_{tot}$	(Y ₂ + C _s)/	Y ₂ /B
	Tables 5+6		DR, Table 18	Tables 5+6	(Y ₁ /Bu ₁)				(Y ₂ /Bu ₂)	
1903-09		50.3	320	522 ²⁾	522	0.4537	0.3480	111.4	1684	0.030
1910-19		55.8	243	579 ²⁾	579	0.415	0.2620	63.7	1244	0.045
1920-29	49.9	52.9	161	280	297	0.3117	0.1452	23.4	429	0.123
1930-39	65.7	64.6	93	381	376	0.2901	0.1489	13.8	456	0.142
1940-49	66.5	75.2	57	478	541	0.3221	0.2147	12.2	629	0.120
1950-59	181.4	180.0	46	1918	1895	0.3906	0.2865	13.2	2033	0.089
1960-64	223.4	205.0	36	1578	1444	0.3032	0.2421	8.7	1505	0.136
1965-69	285.7	291.8	24	2125	2178	0.3213	0.3155	7.6	2234	0.131
1968-72	232.6 ¹⁾	333.0	16	4433 ³⁾	4562	0.4	0.4000	6.4	4649	0.072
1973-77	411.3	407.6	11	4502 ³⁾	4479	0.3249	0.3362	3.7	4520	0.090
	Thurrow.			²⁾ correl. of						
	1997 Table 6			Bu ₁ v Y ₂						
	1969-72 taken			³⁾ Thurrow.						
	as 1968-72			1997 Table 5						
				Y/(F+M)*1.73						

Table 34: Estimation of cod biomass for periods

Period	Y_1 Thurrow, 1997 Tables 7+8	Y_2 DR, Table 17	$C_{10\alpha}=\text{con-}$ sumpt. of seals: DR, Table 18	Bu_1 Thurrow, 1997, Tables 7+8	$Bu_2 =$ Y_2/Bu_1	ΔC_s^i	ΔC_s	$C_s =$ $\Delta C_s^i + 0.0\alpha$	$B =$ $(Y_2 + C_s)/$ (Y_2/Bu_2)	$F =$ Y_2/B
1903-09		5.6	320	13 ³⁾	13	0.0308	0.0236	7.55	31	0.184
1910-19		7.9	243	19 ³⁾	19	0.0371	0.0234	5.69	33	0.242
1920-29	14.1	13.6	161	37	36	0.103	0.0480	7.73	56	0.241
1930-39	25.3	24.3	93	118	114	0.2399	0.1232	11.46	168	0.145
1940-49	99.2	98.0	57	291	287	0.466	0.3106	17.70	338	0.290
1950-59	172.5	172.7	46	395	395	0.222	0.1629	7.49	412	0.419
1960-64	155.0	153.4	36	356	353	0.2021	0.1613	5.81	366	0.419
1065-69	194.1	189.8	24	420	411	0.1653	0.1623	3.90	419	0.453
1968-72	190.6 ¹⁾	197.0	16	445 ¹⁾	460	0.11	0.1100	1.76	464	0.424
1973-77	231.0 ²⁾	218.4	11	598 ²⁾	566	0.112	0.1159	1.27	569	0.384
	¹⁾²⁾ DR, Tabs. 15, 20, 24, and Thu- row 1997 Tab. 8			³⁾ correl. Bu_1 v. Y_2						

Table 35: Estimation of biomass of other species for periods:

Periods	Y_1	Y_2	C_{tot} = consumpt.	Bu_1	$Bu_2 =$	ΔC_{Si}	ΔC_{Si}	$C_s =$	$B =$	$F =$
	Thurrow, 1997	DR,	of seals,	Thurrow, 1997	$Y_2/$			$\Delta C_{Si} \cdot C_{tot}$	$(Y_2 + C_s)/$	Y_2/B
	Table 9	Table 17	DR, Table 18	Table 9	(Y_1/Bu_1)				(Y_2/Bu_2)	
1903-09	19	23	320	106 ²⁾	128	0.8147	0.6249	200.0	1239	0.019
1910-19	38	41	243	199 ²⁾	215	1.1286	0.7126	173.2	1121	0.037
1920-29	44	46	161	212	225	1.729	0.8056	129.7	861	0.053
1930-39	47	48	93	246	250	1.4123	0.7250	67.4	601	0.080
1940-49	58	35	57	271	163	0.7106	0.4737	27.0	288	0.121
1950-59	89	76	46	573	494	0.7456	0.5469	25.2	657	0.116
1960-64	68	82	36	370	469	0.7211	0.5757	20.7	587	0.140
1065-69	73	74	24	479	463	0.5001	0.4911	11.8	536	0.138
1968-72	65 ¹⁾	82	16	580 ²⁾	732	0.47	0.4700	7.5	799	0.103
1973-77	88 ¹⁾	106	11	772 ²⁾	930	0.494	0.4940	5.6	979	0.108
	¹⁾ DR, Tab 15: Tot				²⁾ $Y_1/(Y_1/Bu_1)$					
	minus sprat, cod				where Y_1/Bu_1					
	herring of				mean sprat,					
	these tables				herring, cod,					
					weighted b B_{s1}					

Table 36. Species biomass from yield (DR, Table 17) and interpolated Y₂/B

Year	Sprat	Herring	Cod	Other	Total	Year	Sprat	Herring	Cod	Other	Total
						1950	52	1375	400	475	2302
						1951	65	1587	424	530	2606
						1952	56	1713	486	535	2790
1903	1	1067	33	1133	2234	1953	63	2277	351	566	3257
1904	3	1300	44	750	2097	1954	89	2524	370	664	3647
1905	1	1567	22	824	2414	1955	80	2630	349	770	3829
1906	3	1767	33	833	2636	1956	57	2506	431	726	3720
1907	96	1967	27	2050	4140	1957	150	2023	518	800	3491
1908	123	2167	22	2045	4357	1958	252	2065	412	686	3415
1909	14	1900	31	800	2745	1959	350	1776	382	766	3274
1910	27	1645	33	1556	3261	1960	326	1402	409	758	2895
1911	14	1656	30	1400	3100	1961	407	1406	347	601	2761
1912	27	1229	29	1594	2879	1962	698	1457	356	570	3081
1913	39	1595	25	1400	3059	1963	624	1664	385	448	3121
1914	26	1275	24	1000	2325	1964	960	1592	333	559	3444
1915	24	1279	36	923	2262	1965	912	1601	333	507	3353
1916	57	1313	40	976	2386	1966	1070	1771	386	493	3720
1917	31	1170	28	881	2110	1967	837	2211	428	556	4032
1918	3	1018	36	860	1915	1968	1011	2697	472	590	4770
1919	8	843	44	933	1828	1969	1168	3245	473	541	5427
1920	7	690	52	935	1684	1970	888	6019	472	956	8335
1921	12	490	48	809	1359	1971	1000	6647	413	1024	9084
1922	16	426	44	896	1382	1972	1237	5767	492	1071	8567
1923	25	443	52	920	1440	1973	1556	5247	512	960	8275
1924	14	429	44	980	1467	1974	2449	4593	505	1054	8601
1925	8	351	61	1075	1495	1975	2506	4495	624	1027	8652
1926	8	351	70	909	1338	1976	2726	4125	658	873	8382
1927	7	360	72	778	1215	1977	2549	4340	546	972	8407
1928	14	453	62	833	1362	1978	1900	4126	504	843	7373
1929	10	413	61	677	1161	1979	1257	4452	705	907	7321
1930	13	407	81	692	1193						
1931	25	352	84	662	1123						
1932	31	385	101	671	1188						
1933	34	396	123	581	1134						
1934	43	431	142	584	1200						
1935	59	469	173	588	1289						
1936	78	517	203	619	1417						
1937	19	500	233	573	1325						
1938	38	546	279	656	1519						
1939	6	551	308	420	1285						
1940	3	407	491	196	1097						
1941	3	523	505	310	1341						
1942	4	625	452	210	1291						
1943	4	683	405	205	1297						
1944	8	639	344	296	1287						
1945	4	622	123	270	1019						
1946	5	491	215	286	997						
1947	19	580	285	302	1186						
1948	39	757	359	403	1558						
1949	50	1039	386	426	1901						

Table 37: Catch rates, biomass (Aps) and yield (1000t) of sprat

					continued:				
Year	Laszczins. ¹	GDR ²	Aps ³	Yield	Year	Laszczins.	GDR	Aps	Yield
	tonnes per	tonnes/	VPA-	1000t		tonnes per	tonnes/	VPA-	1000t
	vessel/year	vessel/yr	Biom.			vessel/year	vessel/yr	BIOM.	
1903				0.1	1950	3		176	10
4				0.2	51	1.9		138	12
5				0.1	52	3.2		150	10
6				0.2	53	5.5		134	11
7				7	54	8		107	15
8				9	55	12.9		74	13
9				1	56	1.5		356	9
10				2	57	9.9		532	23
11				1	58	24.1		821	37
12				2	59	28.9		1142	49
13				3	60	18.8		1080	43
14				2	61	20		1144	50
15				2	62	25		1173	81
16				5	63	19.3		1095	68
17				3	64	32.6	5.1	1000	96
18				0.3	65	31.6	5.1	906	83
19				1	66	25.4	6.3	710	92
20				1	67	22.2	5.3	791	72
21	11.3			2	68	26.6	3.8	670	91
22	21.4			3	69	31.4	7.3	859	125
23	23.9			5	70	37	3.5	812	151
24	11			3	71	60.8	5.3	814	184
25	4.3			2	72	73	4.4	896	209
26	2.1			2	73	92.1	4.6	891	210
27	3.3			2	74	118.7	6	671	240
28	6			4	75	125.4	2.5	732	208
29	7.2			3	76	113.1		773	199
30	12.6			4	77	101	5.9	605	181
31	34.1			8	78	57	2.2	448	133
32	43.4			10	79	27.3	2.4	327	88
33	39.6			11	80	31.1		254	58
34	47.2			14	81	21.6		201	49
35	63.5			19	82	32.3		185	49
36	91.5			25	83	17.8		161	37
37	12.4			6	84	23.5		156	53
38	0.9			12	85	48.3		128	70
39	0.4			2	86			93	76
40				1	87			113	88
41				1	Laszczins. ¹ from Laszczynski et al. 1964 and Morski Instytut Rybacki, 1989 DDR ² from Anon. 1974a, 1979a Aps ³ from Aps, 1989				
42				1					
43				1					
44				2					
45	0.02			1					
46	0.5			1					
47	0.2			4					
48	0.9			8					
49	2.9			10					

Table 38: Catch rates and yield (1000 tonnes) of herring

Year	Jensen ¹ tonnes/ vess./ year	Lasz- czynski ² tons/ vess./yr	Sahlin ³ tons/ vess./ year	USSR ⁴ tons/ Vess./ day	Yield 1000t	Year	Jensen tonnes/ vess./ year	Lasz- czynski tons/ vess./yr	Sahlin tons/ vess./ year	USSR tons/ Vess./ day	Yield 1000t
1903					32	1950		8.6	34.1		132
4					39	51		18.9	38.4		146
5					47	52		14.9	29.4		149
6					53	53		33.2	44.4		189
7					59	54		34.7	47.8		207
8					65	55		39.1	53.4		213
9					57	56		46.1	52.6		208
10	19				51	57		19.5			176
11	14				53	58		32.3	61		190
12	23				43	59		29.2	50.3		190
13	22				59	60		35.1	48.9	0.4	178
14	18				51	61		31.2	52.1	0.5	187
15	23				55	62		30.9		0.4	201
16	24				63	63		51.3	62.8	0.8	233
17	21				62	64		35.8	72.1	0.7	226
18	15				62	65		38.9	67.2	0.5	229
19	18				59	66		51.9	72.5	0.8	255
20	10				60	67		57.5		0.56	314
21	19				51	68		74.2	89.9	0.65	356
22	12	7.6			49	69		67.3	80.2	1.17	305
23	12	8.2			54	70		84.4		1.17	319
24	10	7.6			54	71		82.1		0.99	339
25		4.8			46	72		85.2		0.93	346
26		7.6			47	73		95.4	121.3	0.77	404
27		3.2			49	74		107.2		0.61	395
28		2.7			62	75		137.6		0.61	409
29		2.7			57	76		128.7	144.1	0.79	396
30		2.2			57	77		120.4		0.92	434
31		1.5			50	78		127.4		1.24	425
32		1.8			55	79		155.8		1.11	463
33		3.9			57	80		133.2		0.69	460
34		4.1			62	81		123.6			434
35		4.9			67	82		185.5			468
36		6.3			74	83		172.6			485
37		5.2			71	84		168.5			434
38		2.1			77	85		187.1			439
39		10			76						
40					55	Jensen ¹ = Jensen, 1927					
41					69	Laszczynski ² = Laszczynski et al. 1964, and					
42					80	Morski Inst. Ryb. 1989					
43			4.7		86	Sahlin ³ = Sahlin, 1959, and Nat. Centr. Bur. of					
44			10.2		78	Stat. 1933-1980.					
45		8	12.2		74	USSR ⁴ = Anon. 1975a; Anon. 1977a; Anon.					
46		3.2	14.5		57	1981a.					
47		2.2	14		65						
48		1.3	16.2		81						
49		5.2	20.5		107						

Table 39: Yield (1000 tonnes) and catch rates of cod

Year	Känd- ler ¹ kg/h	Lasz- czynski ² tonnes/ vess./yr	Sahlin ³ tonnes/ vessel/ year	Dement- jeva ⁴ t/vess./ day	Yield 1000t	Year	Känd- ler ¹ kg/h	Lasz- czynski ² tonnes/ vess./yr	Sahlin ³ tonnes/ vessel/ year	Dement- jeva ⁴ t/vess./ day	Yield 1000t
1900						1950		125.5	53	1.36	160
1						51		134.6	51.3	1.29	174
2						52		157.5	56.2	1.39	202
3	20				6	53		117.2	40.2	1.14	147
4	0				8	54		125.6	43.1	1.42	156
5	35				4	55		98.3	47.6	1.27	148
6	38				6	56		124.9	48.6	1.66	183
7	50				5	57		130.6			220
8					4	58		76.2	66.2		175
9					6	59		66.7	78		162
10					7	60		94.3	95.8	1.49	173
11					7	61		66.9	97.2	1.47	146
12					7	62		75.1		1.74	149
13					6	63		85.9		1.55	160
14					6	64		74.3	73.2	1.4	139
15					9	65		77.9	72.4	1.49	147
16					10	66		104.7	73.4	2.36	177
17					7	67		100.2		2.55	197
18					9	68		114	80.8	2.59	216
19					11	69		110.3	88.5	2.56	212
20					13	70		125.6		2.28	199
21		0.7			12	71		103.3		2.59	165
22		1.8			11	72		106.7		2.59	193
23		1.8			13	73		92.7	97.8		198
24		0.5			11	74		93.2		2.5	194
25	202	1.3			15	75		139.2		2.6	239
26		1.4			17	76		142.1	138.5	3.06	252
27		1.6			17	77		95.4		2.1	209
28		2.3			14	78		128		3.18	193
29	260	2.3			13	79		196.3		4.29	270
30		1.3			15	80		239.8		5	386
31	340	1.4			14	81		233.5		3.56	382
32		3	1.7		15	82		173.6		2.73	362
33	830	1.9	4		17	83		160.3		2.62	379
34		3.4	10		19	84		200.9		2.66	439
35	990	3.1	26.7		23	85		137.8		2.18	353
36		5.7	32		27	86				1.98	278
37	800	10.7	31.5		31	87				1.75	234
38	1030	7.7	26.2		38	88				1.24	222
39		16.3	29.2		44						
40			13.9		80	Kändler ¹ = Kändler, 1944					
41			19.4		98	Laszczynski ² = Laszczynski et al. 1964, and					
42			37.1		100	Morski Instytut Rybacki, 1989					
43			36.1		104	Sahlin ³ = Sahlin, 1959, and Nat. Central Bureau					
44			33.5		100	Statistics, 1932-1979					
45		32	44.1		39	Dementjeva ⁴ = Dementjeva, 1959 and Anon.					
46		97.5	51.1		72	1992a.					
47		121.9	67.4		102						
48		94.7	84.5	1.82	135						
49		86.3	93.9	1.45	150						

Table 40: Yield and catch-rates of fish species other than sprat, herring, and cod

Year	ICES	Lasz- czynski ¹	Sahlin ² tonnes/ vessel/ year	Yield 1000 tonnes	Year	ICES	Lasc- czynski ¹	Sahlin ² tonnes/ vessel/ year	Yield
	VPA-B	tonnes/ vess/yr				VPA-B	tonnes/ vess/yr		
1900					1950		14.6	1.3	57
1901					1951		13.3	1.2	62
1902					1952		11.5	1.9	61
1903				17	1953		13.7	1.8	64
1904				12	1954		13.1	1.6	75
1905				14	1955		13.5	2.7	87
1906				15	1956		11.5	9.5	82
1907				41	1957		8.3	13.8	92
1908				45	1958		8.4	18.8	81
1909				20	1959		7.7	17.9	95
1910				42	1960		9.8	30.7	100
1911				42	1961		9.8	27.1	83
1912				51	1962		10.3	46.7	81
1913				49	1963		10.9	28.5	64
1914				36	1964		9.7	25.2	81
1915				36	1965		10.4	35.6	74
1916				40	1966		13.7	42.7	72
1917				37	1967		11.4	38.8	79
1918				37	1968		15.6	36.1	79
1919				42	1969		20.4	39.6	66
1920				43	1970	927	22.1	31.9	86
1921		7.4		38	1971	922	29		87
1922				43	1972	849	32.5		90
1923				46	1973	1015	18	27.1	96
1924		2.4		50	1974	840	29		118
1925				57	1975	732	26.8		113
1926				50	1976	819	20	30.9	96
1927		13.7		45	1977	875	23.3		105
1928				50	1978	821	35.9		91
1929				42	1979	759	29.4		98
1930		10.8		45	1980	591	26.5		91
1931				45	1981	482	24.6		73
1932		9.2	30.6	47	1982	459	20.1		65
1933			23.3	43	1983	378	15.2		50
1934			22.9	45	1984	527	17.2		73
1935		7	17.3	47	1985	468	16.3		59
1936			15.7	52					
1937			15	51					
1938		4.9	11.2	61					
1939			8.3	42					
1940			3	21					
1941			5.5	35					
1942			4	25					
1943			3	25					
1944			2.6	37					
1945		16.7	3.8	34					
1946		11.6	5.1	36					
1947		14.6	4.8	38					
1948		14.6	3	50					
1949		21	1.2	52					

Laszczynski¹ = Laszczynski et
al. 1964, and Morski Instytut
Rybacki, 1989

Sahlin² = Sahlin, 1959, and Nat.
Centr. Bureau Stat., 1932-79

Table 41: Biomass, mortality, catchability, and recruitment of sprat

YEAR	est B	vpa B	c/B _{log} /log	c/B _{log}	c/B _{log}	c/Q _{log} /log	c/Q _{log}	est Q	F ₂ =	Y2	F1-7u	c/R
			log B _{ices} V	B _{ices} V.	B _{ices} V.	(cpue) _{pot} /	(cpue) _{pot} /		Y ₁ /c/B _{log}			
			log(cpue)	log(cpue)	log(cpue)	c/B _{log} /log	c/B _{log}		smoothd			
					smoothed		smoothed					
1900												
1												
2												
3	1		11	0	800				0.009	7		125
4	3		22	0	800				0.009	7		125
5	1		11	0	800				0.009	7		125
6	3		22	0	800				0.009	7		125
7	96		764	1163	800				0.009	7		125
8	123		982	1302	800				0.009	7		125
9	14		101	922	790				0.009	8		143
10	27		218	473	652				0.009	6		107
1	14		101	92	531				0.009	5		89
2	27		218	473	442				0.009	4		71
3	39		327	697	442				0.009	4		71
4	36		218	473	629				0.009	6		107
5	24		218	473	664				0.009	6		107
6	57		546	978	684				0.009	6		107
7	31		327	697	608				0.009	6		107
8	3		33	0	534				0.01	5		75
9	8		101	92	502				0.009	5		89
20	7		101	92	588				0.009	6		107
1	12		294	830	663	0.0384	0.014	0.942	0.008	5		109
2	16		581	1126	808	0.0368	0.019	1.338	0.008	4		87
3	25		655	1177	867	0.0363	0.022	0.956	0.01	7		104
4	14		286	817	711	0.0385	0.013	0.786	0.015	7		53
5	8		113	383	538	0.0381	0.011	0.538	0.018	10		55
6	8		61	51	410	0.0344	0.041	0.263	0.022	13		51
7	7		89	260	370	0.0371	0.013	0.471	0.023	8		29
8	14		155	537	470	0.0387	0.011	0.429	0.022	12		47
9	10		186	621	728	0.0387	0.012	0.72	0.017	12		73
30	13		330	880	966	0.0381	0.014	0.969	0.014	12		101
1	25		967	1341	1141	0.0353	0.025	1.364	0.011	9		114
2	31		1263	1453	1315	0.0344	0.03	1.4	0.01	10		149
3	34		1141	1411	1465	0.0347	0.028	1.165	0.009	14		250
4	43		1386	1492	1557	0.0341	0.032	1.098	0.009	16		286
5	59		1928	1629	1441	0.0329	0.039	1.076	0.01	14		209
6	78		2902	1798	1498	0.0315	0.051	1.173	0.01	13		232
7	19		324	873	1540	0.0383	0.014	0.653	0.01	15		224
8	38		35	0	1554	0.0257		0.024	0.01	16		239
9	6		25	0	1535	0.016		0.067	0.01	15		224
40	3				1700				0.01	17		254
1	3				1700				0.01	17		254
2	4				1700				0.01	17		254
3	4				1700				0.01	17		254
4	8				1680				0.01	17		254
5	4		17	0	1620	0.0012		0.005	0.01	16		239
6	5		27	0	1540	0.0185		0.1	0.01	15		224
7	19		21	0	1440	0.0095		0.011	0.01	14		209
8	39		35	0	1328	0.0257		0.023	0.01	13		194
9	50		80	200	1211	0.0363	0.015	0.058	0.01	12		179

Table 41 continued:

YEAR	estB	vpaB	crtB _{log/log}	crtB _{log}	crtB _{log}	crtQ _{log/log}	crtQ _{log}	estQ	F ₂ =	Y ₂	F1-7u	crtR
			logB _{ices} v.	B _{ices} v.	B _{ices} v.	(cpue)pol/	(cpue)pol/		Y ₂ /crtB _{log}			
			log(cpue)	log(cpue)	log(cpue)	crtB _{log/log}	crtB _{log}					
					smoothed		smoothed					
1950	52		527	1139	1144	0.0057	0.014	0.058	0.01	11		164
1	65		421	1016	1088	0.0045		0.029	0.01	11		164
2	56		459	1064	1035	0.007	0.013	0.057	0.01	10		149
3	63		426	1023	968	0.0129	0.011	0.087	0.01	10		149
4	89		363	934	1061	0.022	0.012	0.09	0.01	11		164
5	80		291	805	1187	0.0443	0.014	0.161	0.011	12		152
6	57		975	1479	1358	0.0015		0.026	0.013	14		135
7	150		1404	1672	1576	0.0071	0.013	0.066	0.014	25		210
8	252		2099	1881	1812	0.0115	0.02	0.096	0.016	37		221
9	350		2791	2021	1918	0.0104	0.023	0.083	0.018	49		192
80	326		2524	1987	1985	0.0075	0.018	0.058	0.02	43		197
1	407		2646	2010	2007	0.0076	0.018	0.049	0.022	50		195
2	698		2750	2027	1992	0.0091	0.021	0.036	0.026	81		238
3	624		2555	1991	1979	0.0076	0.018	0.031	0.03	68		157
4	960		2452	1946	1956	0.0133	0.025	0.034	0.035	96		170
5	912		2335	1920	1928	0.0136	0.024	0.035	0.035	83		147
6	1070		2175	1898	1881	0.0117	0.021	0.024	0.04	92		130
7	837		2164	1885	1889	0.0103	0.019	0.027	0.042	72		93
8	1011		1796	1757	1860	0.0148	0.022	0.026	0.046	91		101
9	1168		2543	1987	1865	0.0124	0.024	0.027	0.052	125		113
70	888		1962	1774	1869	0.0189	0.027	0.042	0.065	151		110
1	1000		1922	1922	1903		0.038	0.061	0.071	184		51
2	1237		1907	1907	1890		0.043	0.059	0.088	209		67
3	1556		1925	1925	1880		0.051	0.059	0.108	210		152
4	2449	1813	1924	1924	1813		0.062	0.049	0.107	240	0.167	55
5	2508	1369	1723	1723	1369		0.065	0.05	0.103	208	0.134	26
6	2726	2789	1893	1893	2789		0.06	0.042	0.105	199	0.133	280
7	2549	2234	1885	1885	2234		0.055	0.04	0.094	181	0.128	59
8	1900	1537	1525	1525	1537		0.036	0.03	0.08	133	0.11	27
9	1257	1081	1435	1435	1081		0.019	0.022	0.078	88	0.097	58
80		735	1382	1382	735		0.023		0.073	58	0.115	33
1		779	1261	1261	779		0.017		0.06	49	0.085	83
2		864	1247	1247	864		0.026		0.05	49	0.101	46
3		1967	1155	1155	1967		0.015		0.047	37	0.046	170
4		1548	1156	1156	1548		0.02		0.053	53	0.065	68
5		1162	1110	1110	1162		0.044		0.056	70	0.076	42
6		816	901	901	816				0.073	76	0.101	20
7		1223	996	996	1223				0.076	88	0.151	79
8		767			767				0.072	80	0.15	7
9		1622			1622				0.06	86	0.156	102
90		2207			2207				0.054	86	0.125	102
1		3207			3207				0.037	103	0.126	167
2		3560			3560					142		123
vpaB according to ICES, pers. communication												
crtB _{log/log} from RCT3-programme with logB _{ices} (this Table) versus log(cpue) of Table 37												
crtB _{log} from RCT3-programme with B _{ices} (this Table) versus log(cpue) of Table 37												
crtB _{log} smoothed: according to Holt's smoothing of original crtB _{log} - values												
crtQ, estQ from (cpue)/B, where (cpue) are Polish data												
F ₂ =outliers in F ₁ (=Y ₁ /B ₁) removed, where Y ₁ (DR,Table 17), B ₁ =crtB _{log/log}												
Y ₂ = F ₂ *crtB _{log} crtR:based on: vpa(Y/R)=171.1*vpa(Y/B) ^{1.7042} ,where Y/R found by F ₂												

Table 42: Biomass, catchability, mortality, and recruitment of herring

YEAR	vpaB	estB	C/BP ₀ log/log	C/BP _{0_{est}} log	C/B _{Sw} log/log	C/B _{Eu} log/log	C/QP ₀ cpueP ₀	C/QP _{0_{est}} cpueB ₀	estQP ₀ acc.to	estQSw acc.to	C/QSw F _{Sw}	estY/B B=	Y/vpaB	F3-Bu	estR
			RCT3	B=BiceV	RCT3	RCT3	C/BP ₀	B=BiceV	Polish	Swed.	f-Sw	estB			
			Sw+Dk	logCPUE				logCPUE	effort	effort					
1900															
1															
2															
3		1067										0.030			9.6
4		1300										0.030			11.7
5		1567										0.030			14.1
6		1767										0.030			15.9
7		1967										0.030			17.7
8		2167										0.030			19.5
9		1900										0.030			17.1
10		1645	81	2153			0.16	0.006	0.008			0.031			14.9
1		1656	51	1933			0.196	0.0052	0.006			0.032			15.0
2		1229	115	2328			0.139	0.0069	0.013			0.035			11.3
3		1595	103	2273			0.148	0.0066	0.009			0.037			14.7
4		1275	70	2086			0.171	0.0058	0.009			0.040			11.9
5		1279	115	2328			0.139	0.0069	0.013			0.043			12.0
6		1313	128	2379			0.133	0.0071	0.013			0.048			12.5
7		1170	92	2216			0.152	0.0063	0.012			0.053			11.3
8		1016	51	1933			0.196	0.0052	0.01			0.061			10.1
9		843	70	2086			0.171	0.0058	0.014			0.070			8.7
20		690	28	1634			0.25	0.0043	0.01			0.087			7.5
1		490	81	2153			0.16	0.006	0.027			0.104			5.7
2		426	32	1703			0.238	0.0045	0.018			0.115			5.2
3		443	37	1766			0.222	0.0046	0.019			0.122			5.5
4		429	32	1703			0.238	0.0045	0.018			0.126			5.5
5		351	15	1317			0.32	0.0036	0.014			0.131			4.6
6		351	32	1703			0.238	0.0045	0.022			0.134			4.6
7		360	7	976			0.457	0.0033	0.009			0.136			4.8
8		453	5	834			0.54	0.0032	0.006			0.137			6.1
9		413	5	834			0.54	0.0032	0.007			0.138			5.6
30		407	4	662			0.55	0.0033	0.005			0.140			5.5
1		352	2	340			0.75	0.0044	0.004			0.142			4.8
2		385	3	493			0.6	0.0037	0.005			0.143			5.3
3		396	10	1143			0.39	0.0034	0.01			0.144			5.5
4		431	11	1185			0.373	0.0035	0.01			0.144			6.0

Table 42 continued:

YEAR	vpaB	estB	c/fBPo	c/fBPo _{ov}	c/fBSw	c/fBeu	c/fQPo	c/fQPo _{ov}	estQPo	estQSw	c/fQSw	estY/B	Y/vpaB	F3-Bu	estR
			log/log	log	log/log	log/log	cpuePo/	cpueBPo/	acc.to	acc.to	Fsw/	B=			
			RCT3	B=BiceV	RCT3	RCT3	c/fBPo	B=BiceV	Polish	Swed.	f-Sw	estB			
			Sw+Dk	logCPUE				logCPUE	effort	effort					
50	1375	40	1806	458			0.215	0.0048	0.006	0.025	0.074	0.096			15.5
1	1587	153	2467	563			0.124	0.0077	0.012	0.024	0.068	0.092			17.6
2	1713	102	2268	354			0.146	0.0066	0.009	0.017	0.083	0.087			18.7
3	2277	401	2940	724			0.083	0.0113	0.015	0.019	0.061	0.083			24.5
4	2524	433	2978	823			0.08	0.0117	0.014	0.019	0.058	0.082			27.1
5	2630	531	3078	997			0.074	0.0127	0.015	0.02	0.054	0.081			28.1
6	2506	704	3216	972			0.065	0.0143	0.018	0.021	0.054	0.083			26.9
7	2023	162	2494				0.12	0.0078	0.01			0.087			22.1
8	2065	383	2917	1256			0.084	0.0111	0.016	0.03	0.049	0.092			22.9
9	1776	322	2833	899			0.091	0.010	0.016	0.028	0.056	0.107			20.9
60	1402	422	2987	856	1887	0.083	0.0118	0.025	0.035	0.057	0.127				17.9
1	1406	361	2888	956	2359	0.086	0.0108	0.022	0.037	0.054	0.133				18.5
2	1457	355	2880		1887	0.087	0.0107	0.021			0.138				19.6
3	1664	846	3306	1322	3771	0.061	0.0155	0.031	0.038	0.048	0.140				22.6
4	1592	457	3004	1679	3301	0.078	0.0119	0.022	0.045	0.043	0.142				21.8
5	1601	527	3074	1486	2359	0.074	0.0127	0.024	0.042	0.045	0.143				22.0
6	1771	863	3316	1696	3771	0.06	0.0157	0.029	0.041	0.043	0.144				24.5
7	2211	1029	3402		2641	0.056	0.0169	0.026			0.142				30.3
8	2697	1591	3616	2465	3066	0.047	0.0205	0.028	0.033	0.036	0.132				35.3
9	3245	1346	3534	2020	5508	0.05	0.019	0.021	0.025	0.04	0.094				36.4
70	3817	6019	1984	3724		5508	0.043	0.0227	0.014		0.053	0.084			36.7
1	4405	6647	1891	3701		4661	0.043	0.0222	0.012		0.051	0.077			54.5
2	4326	5767	2016	3732		4381	0.042	0.0228	0.015		0.060	0.08			30.5
3	4621	5247	2445	3827	4146	3630	0.039	0.0249	0.018		0.077	0.087			45.7
4	3540	4593	2987	3925		2876	0.036	0.0273	0.023		0.086	0.112	0.135		38.5
5	3514	4495	4578	4134		2876	0.03	0.0333	0.031		0.091	0.116	0.136	31.3	
6	4055	4125	4085	4075	5591	3722	0.032	0.0316	0.031		0.096	0.098	0.126	60.7	
7	4122	4320	3645	4022		4333	0.033	0.030	0.028		0.100	0.105	0.122	37.1	
8	4479	4126	4012	4069		5837	0.032	0.0313	0.031		0.103	0.095	0.112	42.4	
9	4327	4452	5685	4238		5229	0.028	0.0368	0.035		0.104	0.107	0.137	35.6	
80	4241		4333	4107		3252	0.031	0.0324				0.108	0.143	53.3	
1	3920		3812	4044			0.032	0.0306				0.111	0.165	61.2	
2	4445		7631	4385			0.024	0.0423				0.105	0.155	64.7	
3	3653		6748	4324			0.026	0.040				0.133	0.195	57.9	
4	4001		6477	4304			0.026	0.0391				0.108	0.211	82.0	
5	3802		7747	4392			0.024	0.0426				0.115	0.209	62.9	
6	3318											0.124	0.218	30.9	
7	3639											0.11	0.174	68.4	
8	3976											0.106	0.143	25.7	
9	4205											0.1	0.153	51.6	
90	4864											0.074	0.121	83.4	
1	5024											0.063	0.087	93.0	
2	4708											0.072		92.5	
vpaB = acc to CM 1992/Ass 13															
vpa = ICES VPA-data est= estimated c/f = cpue															
Y/vpaB: Y from DR, Table 17, B from Thurow, 1997, Table 4															
F3-Bu: acc to CM 1992/Ass 13, p. 36															
for other references compare Table 41															

Table 43: Biomass, catchability, mortality, and recruitment of cod

Year	estB	c/B	vpaB	estQP ₀	estQSw	c/rQP ₀	c/rQSw	c/rBP ₀	vpaY/B	estY/B	F4-7u	estR
		log/log		acc.to	acc.to	cpuePo/	cpueSw/	log				
				Polish	Swed.	c/rB	c/rB	Bices V.				
				effort	effort			logcpue				
1900												
1												
2												
3	33	1								0.182		6
4	44	1								0.182		13
5	22	1								0.182		7
6	33	1								0.182		10
7	27	1								0.185		8
8	22									0.182		7
9	31									0.194		10
10	33									0.212		12
1	30									0.233		12
2	29									0.241		12
3	25									0.24		10
4	24									0.25		10
5	36									0.25		16
6	40									0.25		17
7	28									0.25		12
8	36									0.25		16
9	44									0.25		19
20	52									0.25		22
1	48	2							80	0.25		21
2	44	4							156	0.25		19
3	52	4							61	0.25		22
4	44	2							126	0.25		19
5	61	3		0.02		0.4333			133	0.246		26
6	70	3		0.02		0.4667			145	0.243		29
7	72	4		0.02		0.4			181	0.236		29
8	62	5		0.04		0.46			181	0.226		24
9	61	5		0.04		0.46			126	0.213		22
30	81	3		0.02		0.4333			133	0.185		25
1	84	3		0.02		0.4667			210	0.167		23
2	101	6		0.03	0.017	0.5	0.2833		161	0.149		25
3	123	4		0.02	0.033	0.475	1		225	0.138		28
4	142	9		0.02	0.07	0.3778	1.1111		214	0.134		32
5	173	17		0.02	0.154	0.1824	1.5706		288	0.133		38
6	203	28		0.03	0.158	0.2036	1.1429		373	0.133		45
7	233	40		0.05	0.135	0.2675	0.7875		328	0.133		51
8	279	28		0.03	0.094	0.275	0.9357		432	0.136		63
9	308	53		0.05	0.095	0.3075	0.5509			0.143		73
40	491	23			0.028		0.6043			0.163		132
1	505	38			0.038		0.5105			0.194		163
2	452	102			0.082		0.3637			0.221		169
3	405	102			0.089		0.3539			0.257		180
4	344	93			0.097		0.3602	530		0.291		178
5	123	125		0.26	0.359	0.256	0.3528	696		0.317		71
6	215	346		0.45	0.238	0.2818	0.1477	730		0.335		132
7	285	461		0.43	0.236	0.2644	0.1462	692		0.358		189
8	359	420		0.26	0.235	0.2255	0.2012	678		0.376		252
9	386	400		0.22	0.243	0.2158	0.2348	734		0.389		281

Table 44: Biomass, catchability, and mortality of fish species other than sprat, herring, and cod

Year	estB	c/rBPo log/log	c/rBSw log/log	vpaB	estQPo acc.to Polish effort	estQSw acc.to Swed. effort	c/rQPo cpuePo/ c/rBPo	c/rQSw cpueSW/ c/rBSw	est(Y/B)	c/r(Y/B)Po
1900										
1										
2										
3	1133								0.015	
4	750								0.016	
5	824								0.01699	
6	833								0.01801	
7	2050								0.02	
8	2045								0.022	
9	800								0.025	
10	1556								0.02699	
1	1400								0.03	
2	1594								0.03199	
3	1400								0.035	
4	1000								0.036	
5	923								0.039	
6	976								0.04098	
7	881								0.042	
8	860								0.04302	
9	933								0.04502	
20	935								0.04599	
1	809	330			0.00915		0.02242		0.04697	0.11515
2	896								0.04799	
3	920								0.05	
4	980	161			0.00245		0.01491		0.05102	0.31056
5	1075								0.05302	
6	909								0.05501	
7	776	489			0.01765		0.02802		0.05799	0.09202
8	833								0.06002	
9	677								0.06204	
30	692	420			0.01561		0.02571		0.06503	0.10714
1	662								0.06798	
2	671	380	940		0.01371	0.0456	0.02421	0.032553	0.07004	0.12368
3	581		716			0.0401		0.032542	0.07401	
4	584		703			0.03921		0.032575	0.07705	
5	588	319	531		0.0119	0.02942	0.02194	0.03258	0.07993	0.14734
6	619		482			0.02536		0.032573	0.08401	
7	573		461			0.02618		0.032538	0.08901	
8	656	254	344		0.00747	0.01707	0.01929	0.032558	0.09299	0.24016
9	420		255			0.01976		0.032549	0.1	
40	196		92			0.01531		0.032609	0.10714	
1	310		169			0.01774		0.032544	0.1129	
2	210		123			0.01905		0.03252	0.11905	
3	205		92			0.01463		0.032609	0.12195	
4	296		80			0.00878		0.0325	0.125	
5	270	554	117		0.06185	0.01407	0.03014	0.032479	0.12593	0.06137
6	286	440	157		0.04056	0.01783	0.02636	0.032484	0.12587	0.08182
7	302	509	147		0.04834	0.01589	0.02868	0.032653	0.12583	0.07466
8	403	509	92		0.03623	0.00744	0.02868	0.032609	0.12407	0.09823
9	426	642	37		0.0493	0.00282	0.03271	0.032432	0.12207	0.081

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